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REPORT OF PROCEEDINGS
Twelfth Annual Meeting

American Wood-Preservers' Association

7.8321

AT CHICAGO, ILLINOIS
Nineteen Hundred and Sixteen

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PROCEEDINGS

OF THE

Twelfth Annual Meeting

OF THE

American Wood-Preservers' Association

HELD AT

HOTEL SHERMAN, CHICAGO, ILLINOIS

JANUARY 18, 19 and 20, 1916

F. J. ANGIER, Secretary-Treasurer
Mt. Royal Station,
Baltimore, Md.

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J. H. WATERMAN
President, 1915

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CARL G. CRAWFORD
President, 1916

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AMERICAN WOOD-PRESERVERS' ASSOCIATION

Constitution

(Amended 1912, 1915, 1916)

ARTICLE I.

Name and Objects.

SECTION 1. The name of this Association shall be the AMERICAN WOOD-PRESERVERS' ASSOCIATION.

SECTION 2. The objects of the Association shall be the promotion of knowledge of the materials, methods, and principles involved in the economic design, location, construction, maintenance, and operation of wood-preserving works; the standardization of specifications for wood preservatives and for their introduction into the material to be preserved; and the maintenance of high standards of business ethics in the wood-preserving industry.

SECTION 3. The means to be used for these purposes shall be meetings for the presentation and discussion of reports of the experiences and investigations of its members and others, for the interchange of ideas, and for social intercourse; the publication of desirable information; and co-operation with organizations or individuals in work affecting wood-preserving.

ARTICLE II.

Membership.

SECTION 1. The Association shall consist of Corporate, Associate, Probate, and Honorary members.

SECTION 2. A Corporate Member shall be an executive, an administrator, or an operative in a wood-preserving organization; an officer of a public-utility corporation using treated wood whose duties cover the purchasing, inspecting, treating, or distribution of such material; a chemist or an engineer in the employ of a city, county, state, nation, or public-utility corporation; a consulting chemical, civil, electrical, forest, or mechanical engineer; or a professor or an instructor in an institution of learning.

SECTION 3. An Associate Member shall be any person or association of persons interested in wood preservation or in the sale of material or equipment used in the wood-preserving industry.

SECTION 4. A Probate Member shall be an employe of a wood-preserving or inspecting organization who is not eligible for Corporate Membership.

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SECTION 5. An Honorary Member shall be a person of acknowledged eminence in the wood-preserving industry or the sciences relating thereto. The number of Honorary Members shall not exceed five.

SECTION 6. Corporate Members shall have all the rights and privileges of the Association.

SECTION 7. Associate Members shall have all the rights of Corporate Members, except those of voting or holding office.

SECTION 8. Probate Members shall have all the rights of Corporate Members, except those of voting or holding office, for five years from the date of their admission, when their status shall be determined by the Executive Committee.

SECTION 9. Honorary Members shall have all the rights of Corporate Members, except that of holding office, and shall be exempt from the payment of dues.

ARTICLE III.

Admissions and Expulsions.

SECTION 1. Applications for membership and resignations from membership shall be transmitted to the Secretary-Treasurer, the former on a form prescribed by the Executive Committee and endorsed by a Corporate or an Honorary Member. The Secretary-Treasurer shall forward a copy of each application for membership to each member of the Executive Committee, the affirmative votes of a majority of whom shall admit the candidate.

SECTION 2. Proposals for Honorary Membership shall be made by at least ten members, none of whom shall be a member of the Executive Committee. The nominee shall be declared an Honorary Member if he receives the unanimous vote of the Executive Committee or the votes of two-thirds of the Corporate and Honorary members.

SECTION 3. Any member of the Association who resigns while in good standing may be reinstated without paying a second admission fee, provided his application is approved by two-thirds of the Executive Committee.

SECTION 4. For unbecoming conduct a member may be expelled by the votes of two-thirds of the members at an Annual Meeting, after the member has been served with written particulars as to his offense by the Executive Committee, and had an opportunity to be heard by it or by the members at an Annual Meeting.

SECTION 5. The Executive Committee shall accept the resignation, tendered in writing, of any member whose dues are paid.

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ARTICLE IV.

Dues.

SECTION 1. On admission to the Association, members shall pay fees as follows: Corporate Members, $10.00; Associate Members, $15.00; Probate Members, $5.00, which shall include their first dues.

SECTION 2. The annual dues, payable during the first two months of the calendar year, shall be as follows: Corporate Members, $10.00; Associate Members, $10.00; Probate Members, $5.00.

SECTION 3. Members admitted after March 31 shall be exempt from the payment of dues until the following January 1, unless they desire to vote or to receive the current publications of the Association, in which case they shall pay one-half of the annual dues.

SECTION 4. Any member whose dues are unpaid on April 1 shall not receive the publications of the Association, and if his dues are not paid by December 31, his membership shall be canceled, except as provided for in Section 5 of this Article.

SECTION 5. The Executive Committee may extend the time for paying or remit the dues of any Corporate or Probate members who are unable to pay them.

ARTICLE V.

Officers.

SECTION 1. The officers of the Association shall be Corporate Members and shall consist of a President, a First Vice-President, a Second Vice-President, a Secretary-Treasurer, and six Members of Executive Committee, who, together with the last Past-President who is a Corporate Member, shall constitute the Executive Committee in which responsibility for the government of the Association shall be vested. The President shall be chosen from the nine eligible members of the Executive Committee.

SECTION 2. No two or more officers in any year shall be members of the same business organization.

SECTION 3. The President, the First Vice-President, the Second Vice-President, the Secretary-Treasurer, and two Members of Executive Committee shall be elected at each Annual Meeting.

SECTION 4. The terms of the President, Vice-Presidents, and Secretary-Treasurer shall begin at the close of the Annual Meeting at which they are elected and continue until their successors are elected and have qualified. The six Members of Executive Committee shall serve three years, two being elected each year.

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SECTION 5. A vacancy in the office of President shall be filled by the Vice-Presidents in order.

SECTION 6. A vacancy in any office other than that of President shall be filled by an appointee of the Executive Committee.

SECTION 7. The President shall not be eligible for re-election to that office until three others have filled it. A Vice-President shall not be eligible for re-election to the same office until one other has filled it.

ARTICLE VI.

Nomination and Election of Officers.

SECTION 1. At each Annual Meeting six Corporate Members who are not officers shall be elected, together with the three last Past-Presidents who are Corporate Members, to serve one year as a Nominating Committee, of which the senior Past-President shall be chairman.

SECTION 2. The Nominating Committee shall nominate one eligible member for each office and for each membership in the Nominating Committee and shall send its list of nominees to the Secretary-Treasurer before October 15. Any vacancies that may occur in the list of nominees before it is sent to the members shall be filled by the Executive Committee.

SECTION 3. The voting shall not be restricted to the names presented by the Nominating Committee. Any member may file with the Secretary-Treasurer before November 1 the name of a candidate for any office.

SECTION 4. The ballot, with envelopes for secret voting, shall be sent to each member before December 1. It must contain the names of all nominees for each office, arranged alphabetically where there is more than one name for any office, with the nominees of the Nominating Committee plainly indicated.

SECTION 5. Members may scratch or substitute the name of any nominee for any office.

SECTION 6. Ballots shall be sealed and sent or delivered to the Secretary-Treasurer before the polls close, prior to which time a voter may withdraw or replace his ballot.

SECTION 7. The polls shall be closed at noon on the first day of the Annual Meeting, and the ballots shall be counted by one Corporate and four Associate or Probate Members, appointed tellers by the presiding officer at the Annual Meeting.

SECTION 8. The persons who receive the highest number of votes for the offices for which they are candidates shall be declared elected. In case of a tie between candidates for the same office, the members pres-

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ent at the Annual Meeting shall elect the officer from the candidates so tied. The presiding officer shall announce to the meeting the names of the officers elected.

ARTICLE VII.

Management.

SECTION 1. The President shall have general supervision of the affairs of the Association, shall preside at its meetings and those of the Executive Committee, and shall be a member *ex-officio* of every committee except the Nominating Committee.

SECTION 2. The Vice-Presidents, in order of seniority, shall preside at meetings in the absence of the President, and discharge his duties in case of a vacancy in the office.

SECTION 3. The Secretary-Treasurer, under the direction of the President and the Executive Committee, shall be the executive officer of the Association. He shall conduct the correspondence of the Association; record the proceedings of all meetings; collect and deposit all moneys due the Association; verify all bills and pay them when approved by the President or Executive Committee; make at each Annual Meeting a report of the accounts and membership of the Association; and perform such other duties as may be assigned to him by the Executive Committee.

SECTION 4. The Executive Committee shall manage the affairs of the Association, and shall have full power to control and regulate all matters not provided for in the Constitution. It shall act on applications for membership; make appropriations for specific purposes; direct the care of the surplus funds of the Association; and audit the accounts of the Secretary-Treasurer.

SECTION 5. The Executive Committee shall publish the activities of the Association in a book to be known as the Annual Proceedings; but, subject to the action of the Association, it may withhold, in whole or in part, discussions, papers, or reports, the propriety or soundness of which it considers questionable.

SECTION 6. The Executive Committee shall have printed a Manual of Recommended Practice, in which shall be published the specifications and standards approved by the Association in accordance with Article X.

SECTION 7. The Executive Committee shall meet at such times and places as the President may direct, or five members may request in writing. Six members shall constitute a quorum.

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ARTICLE VIII.

Meetings.

SECTION 1. An Annual Meeting, at which the officers shall be elected and all annual reports read, shall be held on the fourth Tuesday in January of each year, at ten o'clock A. M., at such place as the Association at the previous meeting may designate.

SECTION 2. Whenever the President may deem it necessary, or upon the written application of fifteen Corporate Members, he shall direct the Secretary-Treasurer to call a special meeting. The call for such a meeting shall state the time, place, and purpose of the meeting, and shall be mailed not less than thirty days prior to the date of the proposed meeting.

SECTION 3. Twenty Corporate Members shall constitute a quorum at any meeting of the Association.

SECTION 4. The order of business at the meetings of the Association shall be arranged by the Executive Committee, subject to addition or change by the votes of the majority of the members present.

ARTICLE IX.

Amendments.

SECTION 1. Proposed amendments to this Constitution must be offered in writing, signed by at least five Corporate Members, and forwarded to the Secretary-Treasurer not less than thirty days prior to the Annual Meeting. They shall be published with the notices for the meeting.

SECTION 2. Proposed amendments shall be in order for discussion at the Annual Meeting, and may be amended and adopted if two-thirds of the votes of the Corporate and Honorary members present and voting are affirmative.

ARTICLE X.

Adoption of Standards.

SECTION 1. Any proposals for the approval or recommendation by the Association, of definitions, methods, nomenclature, specifications, standard construction, or standard practice, or aimed at defining formally the position of the Association on any matter of importance, shall be presented in writing, with drawings if necessary, at an Annual Meeting. At this meeting amendments may be made by a majority of the Corporate and Honorary members present and voting. Proposed standards shall be referred to letter ballot of the Association if two-thirds of the Corporate and Honorary members at an Annual Meeting vote affirmatively. The affirmative votes of two-thirds of all the Corporate and Honorary members shall be required for the adoption of any standard.

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PAST AND PRESENT OFFICERS OF THE AMERICAN WOOD-PRESERVERS' ASSOCIATION.

No.	Year Elected.	President.	1st V.-P.	2nd V.-P.	3rd V.-P.	Sec.-Treas.
1st.....	1905	J. S. Baker	C. B. Lowry†	H. J. Whitmore†	F. A. Kummer*	C. W. Berry
2nd.....	1906	C. B. Lowry†	E. O. Faulkner	Edmund Christian	David Allerton	C. W. Berry
3rd.....	1907	C. B. Lowry†	David Allerton	Walter Buehler	H. S. Valentine	C. W. Berry
4th.....	1908	Walter Buehler	C. B. Lowry†	David Allerton	H. S. Valentine	C. W. Berry
5th.....	1909	Walter Buehler	David Allerton	H. S. Valentine	H. M. Rollins	C. W. Berry
6th.....	1910	Walter Buehler	C. W. Berry	David Allerton	C. D. Chanute†	F. J. Angier
7th.....	1911	John T. Logan	Andrew Gibson	R. J. Calder	D. Burkhalter	F. J. Angier
8th.....	1912	E. A. Sterling	A. M. Smith	H. M. Rollins	G. B. Shipley	F. J. Angier
9th.....	1913	A. E. Larkin	J. H. Waterman	E. B. Fulks	Geo. E. Rex	F. J. Angier
10th.....	1914	Geo. E. Rex	Carl G. Crawford	R. S. Manley	F. B. Ridgway	F. J. Angier
11th.....	1915	J. H. Waterman	H. S. Loud	Lowry Smith	F. D. Beal	F. J. Angier
12th.....	1916	Carl G. Crawford	John Foley	M. K. Trumbull	.....	F. J. Angier

†Deceased. *Resigned.

In 1915 the Executive Committee was increased to 11 members, the 6 additional members to serve from 1 to 3 years.

The Executive Committee for 1916 consists of the regular officers and the following:

A. R. Joyce (3 years)
F. S. Pooler (3 years)
George E. Rex (2 years)
George M. Davidson (2 years)
J. B. Card (1 year)
V. K. Hendricks (1 year)
J. H. Waterman (1 year)

By constitutional amendment in 1916 the office of Thir d Vice-President was abolished.

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MEETINGS HELD: ATTENDANCE AND PROCEEDINGS.

Year.	City.	Hotel.	Members Present.	Visitors Present.	No. of Pages in Proceedings.	No. of Papers and Reports Presented.
1905.....	New Orleans	St. Charles	15	No record	37	7
1906.....	Chicago	Palmer House	16	No record	56	9
1907.....	Memphis, Tenn.	Baltimore	16	No record	64	10
1908.....	Kansas City, Mo.	Gayoso	No record	No record	Not issued	..
1909.....	Chicago	Auditorium	..	100	141	12
1910.....	Chicago	Auditorium	24	74	190	14
1911.....	Chicago	Auditorium	50	70	302	20
1912.....	Chicago	Sherman	67	..	348	17
1913.....	Chicago	Sherman	83	36	525	22
1914.....	New Orleans	St. Charles	65	43	544	25
1915.....	Chicago	Congress	122	105	527	23
1916.....	Chicago	Sherman	115	89	432	31

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OFFICERS.

Carl G. Crawford.....President
John Foley.....First Vice-President
M. K. Trumbull.....Second Vice-President
F. J. Angier.....Secretary-Treasurer

EXECUTIVE COMMITTEE.

Carl G. Crawford, *Chairman*

Angier, F. J.
Foley, John
Trumbull, M. K.
Joyce, A. R.
Pooler, F. S.
} (Term, 3 Years)

Davidson, G. M.
Rex, Geo. E.
} (Term, 2 Years)
Card, J. B.
Hendricks, V. K.
Waterman, J. H.
} (Term, 1 Year)

STANDING COMMITTEES.

No. 1—Preservatives.

E. B. Fulks, *Chairman*

Acree, S. F.
Church, S. R.
Forrest, C. N.
Fulweiler, W. H.
Kammerer, A. L.
Larkin, A. E.
Steinmayer, O. C.
Taylor, C. M.

No. 2—Specifications for the Purchase and Preservation of Treatable Timber

A. R. Joyce, *Chairman*

Card, J. B.
Goss, O. P. M.
Martin, F. R.
Rex, Geo. E.
Smith, Lowry
Sterling, E. A.
Winslow, C. P.

No. 3—Wood Block Paving.

C. H. Teesdale, *Chairman*

Buehler, Walter
Cherrington, F. W.
Hamilton, F. P.
Loud, H. S.
Newton, H. M.

No. 4—Plant Operation.

A. L. Kuehn, *Chairman*

Hunt, Geo. M.
Lane, C. W.
Lockett, A. M.
McArdle, Frank
Meyer, August

No. 5—Service Tests of Ties and Structural Timber.

C. P. Winslow, *Chairman*

Bowser, E. H.
Ford, C. F.
Gosline, C. E.
Mattos, F. D.
Pollock, Geo. L.
Rollins, H. M.
von Schrenk, Hermann

No. 6—Service Tests of Wood Block Paving.

L. B. Moses, *Chairman*

Calder, R. J.
Dow, Allan W.
Draper, E. G.
Dutton, F. R.
Manley, R. S.
Smith, Phil R.
Williams, J. C.
Winslow, Geoffrey

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SPECIAL COMMITTEES

Publicity, Promotion and Education.

E. A. Sterling, *Chairman*

Bates, John S
Brown, Nelson C.
Hamilton, F. P.
Howson, E. T.
Record, Samuel J.
Ridsdale, P. S.
Schnatterbeck, C. C.
Swan, O. T.

Terminology.

J. B. Card, *Chairman*

Howson, E. T.
Hunt, Geo. M.
Shipley, G. B.
Trumbull, M. K.

Program.

John Foley, *Chairman*

Davidson, G. M.
Hendricks, V. K.
Joyce, A. R.
Trumbull, M. K.

Entertainment.

Jesse I. Eppinger, *Chairman*

Draper, E. G.
Lembcke, G. A.
Loud, H. S.
Shipley, L. B.
Williams, J. C.

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MEMBERSHIP.

c-Corporate. a-Associate. p-Probate. h-Honorary.
Figures indicate serial number of Membership Certificates.

183 c ALEXANDER, E. E.....General Foreman, Timber Preserving Plant, Baltimore and Ohio R. R. Co., Green Spring, W. Va.
29 c ALLARDYCE, R. L.....Supt. International Creosoting & Construction Co., Texarkana, Tex.
21 c ALLERTON, DAVID.....Carlotta, Cal.
1 c ANGIER, F. J.....Supt. of Timber Preservation, Baltimore and Ohio R. R. Co., Baltimore, Md.
274 c APPEL, HARRIS A.....Engineer, Bruno Grosche & Co., 90 Wall Street, N. Y.
2 c ARMSTRONG, R. L.....636 Burdette St., New Orleans, La.
105 c BACON, W. L.....Supt. Tie Treating Plant, C. & N. W. Ry., Escanaba, Mich.
225 c BAKER, HUGH P.....Dean, New York State College of Forestry, Syracuse, N. Y.
3 h BAKER, J. S.....Box 22, Paducah, Ky.
167 c BATEMAN, ERNEST.....Chemist Forest Products Laboratory, Madison, Wis.
246 c BATES, JOHN S.....Supt. Forest Products Laboratories, McGill University, Montreal, Canada.
88 c BATSON, C. D.....Manager, Republic Creosoting Co., Mobile, Ala.
4 c BEAL, F. D.....Sales Engineer, Chas. R. McCormick & Co., 800 Fife Bldg., San Francisco, Cal.
255 c BEATY, R. ERNEST.....Expert Inspector, Borough of Manhattan, 30 Church St., New York.
198 c BECKER, A. C.....Chief Tie & Timber Inspector, Grand Trunk Ry., Montreal, Canada.
295 a BELANGER, ERNEST....Consulting Engineer, Elder Ebano Asphalt Co., 364 University St., Montreal, Canada.
145 c BELCHER, R. S.....Supt. Treating Plant, Santa Fe Tie & Lumber Pres. Co., Somerville, Tex.
144 c BERK, P. F.....Chemical Mfr., F. W. Berk & Co., Ltd., 1 Fenchurch Ave. London, England.
5 h BERRY, C. W.....Consulting Engineer, care of J. B. Berry, Transportation Bldg., Chicago, Ill.
300 c BLACK, JAMES M.....Paving Block Expert, 203 Pasadena Apts., Jefferson & Du Bois Sts., Detroit, Mich.
22 c BOEHNE, E. E.....Office Manager, International Creosoting & Construction Co., Galveston, Tex.
258 c BOOK, J. E.....Treating Engineer, Pacific Creosoting Co., Creosote, Wash.
244 c BOWSER, E. H.....Supt. of Timber Department, I. C. R. R., Memphis, Tenn.
267 a BOYD, J. L.....Chief Engineer Creosoted Block Paving Co., Royal Bank Bldg., Toronto, Canada.
175 c BRANNON, CLIFTON....Division Engineer, C. & E. I. R. R. Co., Evansville, Ind.
280 p BRENNAN, T. S.....Lumber Inspector, A., T. & S. F. Ry., Box 503, Ballard Station, Seattle, Wash.
301 c BRIGHT, EDGAR W.....Tie & Timber Agent, Boston Elevated Rwy. Co., 101 Milk St., Boston, Mass.
230 c BROWN, NELSON C.....Professor of Forest Utilization, New York State College of Forestry, Syracuse, N. Y.
122 c BRUNING, HEINRICH...(Robert A. Munro & Co., 31 Liberty St., New York City) Hubertusmuhle, Schopfurth, Mark, Germany.
23 c BUEHLER, WALTER.....Vice-Prest., Butler-Coons Contracting Co., 3505 Bellefontaine Ave., Indianapolis, Ind.
24 c BURKHALTER, D.....American Creosoting Co., Box 77, Russell, Ky.
83 a CABOT, SAMUEL.....Mfg. Chemist, 141 Milk St., Boston, Mass.
30 c CALDER, R. J.....Secy.-Treas., International Creosoting & Construction Co., Galveston, Tex.
190 c CAMPBELL, J. H.....Chief Chemist, R. W. Hunt & Co., 2200 Insurance Exchange, Chicago, Ill.

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43 c CARD, J. B.....Manager, Chicago Creosoting Co., 30 N. LaSalle St., Chicago, Ill.
276 c CECIL, WM. A.....Wood-Preserving Engineer, Indiana Tie Co., Citizens National Bank Building, Evansville, Ind.
257 c CHADBOURNE, B.....Asst. Supt., Pacific Creosoting Co., Creosote, Wash.
302 c CHAPIN, E. T.....Prest., The E. T. Chapin Co., 2008 Railway Exchange Bldg., St. Louis, Mo.
69 c CHERRINGTON, F. W....Chief Engr., Jennison-Wright Co., 313 Huron St., Toledo. O.
19 c CHRISTIAN, EDMUND...Gen. Mgr., Norfolk Creosoting Co., Norfolk, Va.
57 a CHURCH, SUMNER R....Manager Research Dept., The Barrett Co., 17 Battery Place, New York.
165 c CLARKE, G. S..... Vice-Prest. & Gen. Mgr., The Reeves Co., 809 Whitney-Central Bldg., New Orleans, La.
184 c CLARK, W. DENNISON..Vice-Prest. & Gen. Mgr., Columbia Creosoting Co., 810 Lewis Bldg., Portland, Ore.
318 c CLEMENTS, A. B..... Vice-Prest., United States Wood Preserving Co., 165 Broadway, New York.
174 c CLIFTON, W. H..... Lumber Agent, Baltimore & Ohio R. R. Co., Baltimore, Md.
249 c COBEAN, CHAS. E.....Supt., Pacific Creosoting Co., Creosote, Wash.
188 a COCKE, W. H.....Prest., Commercial Acid Co., 3943 Duncan Ave. St. Louis, Mo.
157 c COLLIER, H. L.....Con. Engr., Candler Bldg., Atlanta, Ga.
218 c COLLIVER, S. R.....Treatment Inspector, A., T. & S. F. Ry., Topeka, Kan.
67 c COLMAN, GEO. A.....The J. M. Colman Co., Colman Bldg., Seattle, Wash.
221 c COOPER, S. D.....Chief Inspector, A., T. & S. F. Ry., Topeka, Kan.
31 c CRAWFORD, CARL G....Gen. Mgr., American Creosoting Co., 808 Columbia Bldg., Louisville, Ky.
80 c CURTIS, W. W.....Prest. & Treas., The Rapson Coal Mining Co., Box 485, Colorado Springs, Colo.
25 c DAVIDSON, G. M.....Chemist & Engineer of Tests, C. & N. W. Ry. Co., Chicago, Ill.
143 c DAVIES, E. T.....Inspector, City Engineer's Office, Minneapolis, Minn.
84 c DE CEW, J. A.....Chemical Engineer, McGill Bldg., Montreal, Canada.
272 c DELIUS, E. A.....Bookkeeper, Pacific Creosoting Co., Seattle, Wash.
204 c DEMUTH, R. E.....Testing Engineer, 22 Hayward Ave., Baltimore, Md.
223 c DIXON, G. C.....Tie Treating Inspector, N. Y. C. Lines, Box 763, Indianapolis, Ind.
64 c DIXON, J. H.....Forestry Branch, Dept. Natural Resources, Canadian Pac. Ry., Calgary, Alberta, Canada.
119 c DOUGHERTY, CURTIS...Chief Engineer, Queen & Crescent R. R., Cincinnati, O.
303 c DOVEY, J. THOMAS.....Prest., The Seattle Engineering Co., 724 Central Building, Seattle, Wash.
290 c DOW, ALLAN W.....Consulting Engineer, Dow & Smith, 131 E. 23rd St., N. Y.
121 c DRAPER, E. G.....Prest., American Creosoting Co. of N. J., 17 Battery Place, New York.
166 a DREFAHL, LOUIS C.....Chemist, Grasselli Chemical Co., 880 The Arcade, Cleveland, Ohio.
93 c DRINKER, W. W.....Asst. Engineer, Erie R. R. Co., 50 Church St., New York.
178 c DUNSTAN, J. H.....Supt., Southern Creosoting Co., Slidell, La.
211 c DURHAM, J. H.....Vice-Prest., American Creosoting Co., Louisville, Ky.
322 c DUTTON, ELLIS R.....Asst. City Engr., City Hall, Minneapolis, Minn.
202 a EASTWICK, CHAS. H....Prest., The Northeastern Co., 6 Beacon St., Boston, Mass.
297 a ELLIOTT, J. A.....Tie & Timber Contractor, 1609 Mound Ave., Jacksonville, Ill.
275 c EMERSON, HARRINGTON Prest., The Emerson Co., 30 Church St., New York.
76 c EPPINGER, JESSE I.....Gen. Mgr., Eppinger & Russell Co., 165 Broadway, New York.
163 c ERICSON, L. T.....Engineer, American Creosoting Co., of N. J., 17 Battery Place, New York.
158 c FANT, A. E.....Gen. Mgr., Gulfport Creosoting Co., Gulfport, Miss.
9 h FAULKNER, E. O.....Mgr., Tie & Timber Dept., A., T. & S. F. Ry., Kerckhoff Bldg., Los Angeles, Cal.

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239 c FERGUSSON, HUBERT..Gen. Mgr., Burt, Boulton & Haywood, Ltd., Prince Regent's Wharf, Silverton, Victoria Docks, London, England.
217 c FINKE, W. F. H.....Tie & Timber Agent, Southern Ry. Co., Washington, D. C.
62 c FISHER, WM. A.....Supt. of Timber Preservation, Atlantic Coast Line, care of Chief Engineer, Wilmington, N. C.
308 a FOERSTERLING, DR. H..Vice-Prest., Roessler & Hasslacher Chemical Co., 380 High St., Perth Amboy, N. J.
77 c FOLEY, JOHN.....Forester, P. R. R. Co., Broad St. Station, Philadelphia, Pa.
106 c FORD, C. F.....Supt. Tie and Timber Dept., C., R. I. & P. R. R. 325 LaSalle St. Sta., Chicago, Ill.
296 c FORREST, CHAS. N.....Chief Chemist, Barber Asphalt Paving Co., Maurer, N. J.
313 c FOWLER, J. W.....Asst. Efficiency Engineer, Baltimore & Ohio R. R. Co., Baltimore, Md.
117 c FREY, GEO. W.....Secy.-Treas. & Mgr., Compressed Wood Preserving Co., 4600 Spring Grove Ave., Cincinnati, O.
38 c FULKS, E. B.....Vice-Prest., American Tar Products Co., 208 S. LaSalle St., Chicago, Ill.
160 a FULWEILER, W. H.....Chemist, United Gas Improvement Co., 1706 N. Broad St., Philadelphia, Pa.
306 a FURLONG, L. A.....Vice-Prest., The Valentine-Clark Co., Security Bldg., Minneapolis, Minn.
44 a GERHARD, H. H.....Prest. C-A Wood-Preserver Co., 807 Wright Bldg., St. Louis, Mo.
39 c GIBSON, ANDREW.....Engineer Maintenance of Way, No. Pac. Ry., St. Paul, Minn.
161 a GIBSON, LOUIS S.....Secy. Sandoval Zinc Co., 410 N. Peoria St., Chicago, Ill.
180 a GIBSON, W. C.....Sales Engineer, Allis-Chalmers Mfg. Co., Milwaukee, Wis.
316 p GOLDSTEIN, H. I.....Highway Inspector, Bureau of Highways, Dept. of Public Works, 4200 Woodland Ave., Philadelphia, Pa.
56 c GOLTRA, W. F.....Prest., W. F. Goltra Tie Co., Rockefeller Bldg., Cleveland, O.
169 a GOODLETT, EARL G.....1505 Jefferson County Bank Bldg., Birmingham, Ala.
288 c GOSLINE, C. E.....Treating Inspector, D., L. & W. R. R. Co., Paterson, N. J.
277 c GOSS, O. P. M.....Consulting Engineer, Seattle Wash.
243 c GRADY, W. H.....Asst. Gen. Supt., American Creosoting Co., Louisville, Ky.
100 c GRAHAM, FLOYD N.....Timber Inspector, C. G. W. R. R. Chicago, Ill.
170 c GREEN, DONALD W.....Secy., Columbia Creosoting Co., 809 Lewis Bldg., Portland Ore.
232 c GRIFFIN, RUSSELL A...Mgr. Pole Dept., Western Electric Co., 463 West St., New York.
72 a GROW, J. H.....Sales Engineer, Allis-Chalmers Mfg. Co., Milwaukee, Wis.
48 c HAGEBOECK, A. E.....Care of H. J. Frank Fdy. and Mach. Co., 1739 W. 2d St., Davenport, Iowa.
231 c HAGGANDER, G. A.....Asst. Bridge Engineer, C., B. & Q. R. R. Co., 547 W. Jackson Blvd., Chicago, Ill.
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195 c HAMILTON, F. P.....Paving Engineer, 601 Interstate Bank Bldg., New Orleans, La.
214 c HAMNETT, W. S.....Vice-Prest. & Mgr., Pittsburgh Testing Laboratory of Texas, 505 Praetorian Bldg., Dallas, Tex.
213 c HARDEN, G. S.....Supt. Timber Preserving Plant, B., R. & P. Ry., Bradford, Pa.
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53 a HAWKES, A. W.....Sales Manager, General Chemical Co., 112 W. Adams St., Chicago, Ill.
236 c HELSON, J. R.....Supt., Watkins Creosoting Co., Metropolis, Ill.
103 c HENDRICKS, V. K.....Asst. Chief Engineer, St. Louis & San Francisco Ry. Co., Frisco Bldg., St. Louis, Mo.
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193 c HOWSON, E. T.....Engineering Editor, "Railway Age Gazette," Transportation Bldg., Chicago, Ill.
265 c HUNT, GEO. M.....Chemist, Forest Products Laboratory, Madison, Wis.
224 c IKIN, A. J.....Cost Statement Engineer, Southern Pac. Co., Box 6, Kern, Cal.
299 p IRVING, A. E.....Clerk, Tie Plant, Baltimore & Ohio R. R. Co., Green Spring, W. Va.
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260 c JOHNSON, J. A.....Foreman, Tie Preserving Plant, U. P. R. R. Co., Box 303, Laramie, Wyo.
136 a JOHNSON, J. H.....B. Johnson & Son, Richmond, Ind.
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118 a LEWIS, WM. H.....Vice-Prest., F. J. Lewis Mfg. Co., 2500 S. Robey St., Chicago, Ill.
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242 c LOOK, RICHARD V.....Prest., Canada Creosoting Co., Ltd., 1 King St., E., Toronto, Can.
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309 c MURCHIE, WILFRED E..Consulting Inspector, Shillito & Murchie, Maritime Exchange Bldg., New York.
240 c MURRAY, D. L.....Gen. Foreman, Tie Plant, Santa Fe Tie & Lbr. Pres. Co., Somerville, Tex.
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314 a NIXON, WARREN C.....Secy., Western Tie & Timber Co., 905 Syndicate Trust Bldg., St. Louis, Mo.
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284 c QUINCY, R. B.....Representing R. W. Hunt & Co., 1022 Hibernian Bldg., New Orleans, La.
261 c RAWSON, R. H.....Supt. of Plant, St. Helens Creosoting Co., St. Helens, Ore.
155 c RECORD, S. J.....Asst. Prof., Forest School, Yale University, New Haven, Conn.
226 c REDMAN, KENNETH.....Chemist, Pacific Creosoting Co., Creosote, Wash.
54 c REX, GEORGE E.....Manager Treating Plants, A., T. & S. F. Ry., Topeka, Kan.
228 a RIDSDALE, P. S.....Secy., American Forestry Ass'n, 1410 H St., N. W., Washington, D. C.
131 c ROBERTS, G. G.....1 Clarges St., Piccadilly W., London, England.
278 p ROBINSON, DONALD....Student in Chemistry, 6538 Norman Blvd., Chicago, Ill.
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311 c ROTH, E. J.....Purchasing Agent, C. I. & L. Ry., 608 S. Dearborn St., Chicago, Ill.
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241 a RUEPING, MAX.....Owner, Hulsberg & Co., Lessingstra, Berlin, Germany.
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206 c SCHNATTERBECK, C. C. Editor, "Wood-Preserving," Baltimore, Md.
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210 c SEXTON, C. H.....Supervising Inspector, Western Electric Co., 463 West St., New York.
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154 a SHIPLEY, L. B.....Chemist, The Barrett Co., 17 Battery Place, New York.
89 c SHUFORD, C. S.....Supt., Republic Creosoting Co., Mobile, Ala.
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262 a SJODAHL, H. A.....Chemist, Chatfield Mfg. Co., Station P, Cincinnati, O.
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289 a SMITH, R. G.....Engineer & Chemist, Standard Oil Co., 200 Bush St., San Francisco, Cal.
216 c SMITH, V. C.....Consulting Engineer, Government Railroads of India, care of Bank of Bengal, Calcutta, India.
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58 c STERLING, E. A.....Mgr., Trade Extension Dept., Nat'l Lumber Mfr's Assoc. 925 Lumber Exchange, Chicago, Ill.
238 a STERNBERG, DR. LEO...Manager, Hulsberg & Co., Lessingstra, Berlin, Germany.
13 c STEWART, F. H.....Supt. Creosoting Plant, Central of Georgia Ry., Crump's Park, Ga.
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129 a SWINK, ROBERT B.....Gen. Mgr., Southern Tie & Lumber Co., Medon, Tenn.
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172 c TEESDALE, CLYDE H...Asst. Engineer, Forest Products Laboratory, Madison, Wis.
94 a TESHIMA, TOMOTAKE..Asst. Mgr., Engrg. Dept. Mitsui & Co., 25 Madison Ave., New York.
87 c TIFFANY, C. W.....Gen. Mgr., Acme Tie Co., Reed City, Mich.
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197 c TOWNSEND, T. G.....Timber Treating Inspector, Southern Ry., Washington, D. C.
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65 c VAN METRE, RICKER...Joyce-Watkins Co., 332 S. Michigan Ave., Chicago, Ill.
207 a von BERNUTH, OSCAR...Prest. Lembcke, von Bernuth Co., 171 Madison Ave., New York.
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46 c von SCHRENK, DR. H....Consulting Engineer, Tower Grove & Fladd Aves., St. Louis, Mo.
256 c WALLACE, H.....Supt., Canada Creosoting Co., Ltd., Trenton, Ontario, Can.
111 a WALSH, P. R.....Prest., Walsh-Griffith Tie & Timber Co., 718 Title Guaranty Bldg., St. Louis, Mo.
81 c WATERMAN, J. H.....Supt. of Timber Preservation, C., B. & Q. R. R. Co., Galesburg, Ill.
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173 c WEGENER, RALPH H....Inspector, St. Paul & Tacoma Lumber Co., 902 North M. St., Tacoma, Wash.
305 a WEGENER, RICHARD....Preservatives Salesman, 627 27th St., Milwaukee, Wis.
79 b WEISS, HOWARD F.....Director, Forest Products Laboratory, Madison, Wis.
171 c WELSH, C. T.....Asst. Plant Operator, Republic Creosoting Co., Plymouth Bldg., Minneapolis, Minn.
177 c WHITE, THOS.....Asst. Mgr., American Creosote Works, Station B, New Orleans, La.
149 c WIGGETT, C. H.....Supt. Tie Plant, El Paso & Southwestern System, Alamogordo, N. M.
47 c WILLIAMS, J. C.....Supt. Wood-Preserving Works, Barber Asphalt Paving Co., Maurer, N. J.
138 c WILLIAMS, R. R.....Vice-Prest. & Treas., Indiana Tie Co., Citizens National Bank Bldg., Evansville, Ind.
245 c WILLIAMSON, H. E.....Gen. Foreman Timber Preserving Plant, C., B. & Q. R. R., 307 E. First St., Sheridan, Wyo.

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235 c WIRTH, PHILIPP.....Prest. Anthrol Wood Preserving Co., 332 Spring St., New York.

259 c WOODWARD, G. W.....Asst. Supt. Timber Preserving Plant, B., R. & P. Ry. Co., Bradford, Pa.

298 c WRIGHT, W. E.....Manager Sales, Jennison-Wright Co., 313 Huron St., Toledo, O.

42 c YARBROUGH, R. W.....2901 Clark St., Houston, Tex.

234 c ZWINGAUER, N.....Director, Rutger Works, Lutzowstrasse, Berlin, Germany.

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Crawford, Carl G.
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OPENING SESSION.

The Twelfth Annual Meeting of the American Wood-Preservers' Association, held at Hotel Sherman, Chicago, Illinois, January 18, 19, 20, 1916, was called to order by its President, Mr. J. H. Waterman, Tuesday morning, January 18, at 10 o'clock.

THE PRESIDENT: The Twelfth Annual Meeting of the American Wood-Preservers' Association is now called to order. Dr. John Timothy Stone, Pastor of the Fourth Presbyterian Church, Chicago, will lead us in prayer.

DR. JOHN TIMOTHY STONE: Let us pray. Eternal God, our Father in Heaven, from whom all blessings and gifts come, thou who hast created this world that we might live therein and use that which thou hast given, we thank Thee for the blessings of the great forests. We thank Thee, oh, God, for all the gifts of growth related thereto. Help us to learn those lessons which are related to great practical issues of life, and may life not only be strengthened and helped and upheld and preserved by giving to us the victory over human life, over human and material conditions in that our own hearts and lives may learn the principles of honor and truth and that business and righteousness may go hand in hand. Bless the various meetings of this convention. Bless the stay of these our guests in our city and give to us all a sense of the brotherliness of service and of the majesty of honor and of the faithfulness and diligence of true manhood and true character. We ask it in the name of our Master and for His sake. Amen.

THE PRESIDENT: I now have the pleasure of introducing to you a man who needs no introduction, who will give us an address of welcome. He is a pioneer railroad man, a man of national reputation and thoroughly interested in wood preservation. Mr. Kendrick will now address you (applause).

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MR. J. W. KENDRICK: Mr. President, ladies and gentlemen and members of the American Wood-Preservers' Association: I take great pleasure in welcoming you to Chicago and I welcome you not only as a citizen of this city, but if I may be allowed to use the term, as fellow craftsmen, men with whom I have something, and a great deal, in common. While I do not feel that it is incumbent upon me to deliver a technical address because the technology of timber preservation is complex and the subject in its everchanging development can best be treated as it will be by those to whom the discussion of certain of its phases has been intrusted, taking as I do a very deep interest in this one of the greatest of economic subjects that is now pressing upon us for consideration, I feel that this occasion should not be allowed to pass without embracing the opportunity to make a very brief statement regarding some phases of the work that is being carried on by you. While your Association is one of the youngest of the many national bodies that have to do with various scientific subjects, its work is broad in scope and of the highest national importance. In fact, it walks hand in hand with conservation—conservation of resources, national and private—conservation of materials and especially of timber that was once referred to as inexhaustible.

As this Association is now holding its twelfth annual meeting, it must have been established a short time before the meeting of the International Railway Congress in Washington in May, 1905. Perhaps it may be said that at that time an impetus was given to the general subject of timber preservation, especially in connection with railway uses, and more particularly as regards the treatment of cross ties, and I like to think that this may have marked a new era in the science, because in 1903 I was asked to act as a correspondent and to present the facts that I was able to collect with respect to the supply, treatment and general conservation of railroad sleepers or cross ties. My investigations commenced in 1903, and took the form of questions which were propounded to the officers of 211 railroad companies. One hundred and two of those addressed made replies. Sixty-one replied to the question as to how long the local tie supply would last under the conditions and requirements that then existed as follows:

Supply exhausted	8 roads
Will last from 1 to 5 years	19 "
Will last from 5 to 10 years	22 "
Will last 20 years	6 "
Will last an indefinite period	6 "

It may be stated that the opinion was generally expressed that the national supply of timber would be generally exhausted in 20 or 25 years, or in 1925 or 1930. Speaking now, 10 years after the date of the convention of the International Railway Association and after that estimate was made, the views then taken seem to have been

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unduly pessimistic. It is true that concrete, especiallly reinforced concrete, has taken the place of timber for many uses. We have passed through periods of depression which have resulted in reducing the lumber cut, and while it is undoubtedly true that the supply of cross ties and timber in certain other localities than those that were mentioned or referred to at the time that the data were gathered for the convention in 1905, has become exhausted, there is generally speaking no evidence, at least in a popular sense, that there is a shortage of timber in this country. I find that in 1907, Gifford Pinchot estimated the timber supply of the United States, taking into account the annual forest growth, to be sufficient to meet the requirements for 33 years, or until 1940. In 1907, someone made an estimate that there were twenty-five hundred billion feet, board measure, of timber standing in the United States and that of this stand five hundred billion feet were hardwood. Personally, I think that estimates as to the amount of timber that is standing, those that have been made and those that will be made in the near future, are very likely to be under rather than over estimates. Formerly, it was the custom in cruising land to estimate only those varieties of timber that were then merchantable, and I personally know of large tracts that were cruised in that way and within a few years afterwards certain timbers that existed in enormous quantity upon these lands which were not merchantable at the time it was originally cruised became marketable, and, of course, the scale of timber upon those lands was correspondingly increased. But when we consider that in 1907, 144,000,000 cross ties were used in this country, representing more than 7,000,000,000 ft. of timber, and that the mileage of the roads of the country at that time was probably a little less than 200,000 miles of main track, and that the railroad systems of the country are destined to be extended, the mileage vastly increased, that the consumption of cross ties will be correspondingly increased, we must be impressed not only by the vastness of the problem but by the fact that whether the pinch of necessity or the pinch due to the shortage of timber supply is evidenced within 30, 40 or 50 years, that the future timber supply is of such importance at the present time that it behooves those who are large consumers, those who must in the future be large consumers of lumber and of timber to adopt ways and means to insure the continuance of that supply, for certain uses there has been no substitute found for timber, nor does there seem likely to be any such substitute found.

In 1905, the treatment of timber in this country was in its infancy; it might almost be said that there was no such thing as treatment of timber. I do not suppose that at that time there were 20 plants. What had been done was very largely experimental.

Without going into the history which has been repeated time and time again and which is very meager, it may be stated that in 1886

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the Chicago, Rock Island & Pacific Railway System, having previously tried the Burnettizing process with success made a contract with Card and Chanute, later the Chicago Tie Preserving Co., to treat a specified number of ties each year by the Wellhouse or zinc-tannin process, and prior to this, very little more had been done by any of the railroads than to conduct certain tests in regard to increased durability of cross ties by chemical treatment.

In 1885 the Atchison, Topeka & Santa Fe Railway Co. constructed a tie treating plant at Las Vegas, N. M., and concurrently, or perhaps a little before that time, the Southern Pacific embarked upon the practical treatment for the preservation of cross ties.

I wish to say a word at this point about my old friend, Octave Chanute. Mr. Chanute was the champion of this great economic development (applause). The cause could not have had a better or worthier knight. Mr. Chanute had a long and distinguished engineering career. He essayed many important undertakings. The greater part of his life was spent in a period in which general engineering practice was followed to a greater extent than in later days, so that Mr. Chanute's experience embraced a great variety of undertakings, some of them somewhat humble and unpretentious, up to, and including, the designing and construction of important bridges and embraced what afterwards became his principal closing life work, the preservation of timber against decay. So varied was his practice that it embraced the study of aeronautics and some practical experiments with gliding planes. No more competent or worthy exponent of that science and craft which is represented in all its varied aspects by the members of this Association could possibly have been found; a man with the highest attainments, of most sterling integrity, of indomitable courage, he was the embodiment of all that is desirable and necessary in the prosecution of a business in which personal honor stands for so much.

It is my understanding that your Association has set up certain ideals toward which it is working, which may be stated as follows: The promotion of the use of wood for all purposes to which it is adapted. The preservative treatment of wood whenever decay is apparent. The development of materials and processes for the effective treatment of wood. The economical operation of wood-preserving plants, and the general conservation of all forest products.

This is indeed a vast field and one which requires not only the highest aspiration but the exercise of the highest talents and indomitable will power. Wood preservation must and does depend to a very great extent upon the faithful and honorable prosecution of the various processes to which it may be subjected. The user of wood knowing that it will last unprotected from six to eight years, feels

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that he is justified in making a further investment to insure its longer life. He has a right to expect information as to the extent to which the durability of the timber so treated will be increased, and this information should be forthcoming and it should be based on facts that can best be gathered by your Association. It is, therefore, important and indeed necessary that your members should be conversant not only with methods of treatment but with the results that will attend the adoption of each or any of these methods, and this involves not only the maintenance of proper forms of record but a knowledge of the uses to which the timber is to be put.

I find in my going through the land and in my contact with this subject that there seems to be in a sense an unfortunate lack of unity of purpose in connection with the treatment of timber. There are those who treat the timber as the gentlemen who are members of this Association do, who are supposed to know all about it, and do know all about it. There are those who use the timber, who incorporate it in the work for which it is intended, who have to do with it afterwards, and I am impressed more and more as I consider this subject that it is very desirable and necessary to have a great get-together meeting for the purpose of considering the matter from the time the timber is treated until the time it finally decays, and decay altogether more frequently happens because of its wanton destruction for the lack of the exercise of ordinary common sense in protecting it from mechanical wear.

Many uses require protection from decay, others must also take into consideration the deterioration from mechanical causes.

If treated timber is to be exposed to air and moisture, or is to be immersed in water, the records of the past are fairly complete as to the durability that may be expected, and the effect of natural agencies.

In regard to treatment by any method still unknown or experimental, it may be that its efficacy can be indicated by tests made in laboratories. I understand these tests (in rotting pits) have not proven to be satisfactory because it takes a certain length of time for the decay spores to mature and to exercise their destructive functions and that the results that are obtained in what may be termed laboratory tests do not run parallel or concur with those that are obtained in practice.

It occurs to me that it would be extremely useful, speaking especially from a railroad standpoint, if the railroads could in combination and did, after our neighbor at the south has settled its difficulties so that it is possible to do anything of a peaceful nature, secure a stretch of experimental track near Tampico, a place where natural woods of any kind that I know of will not last more than one year, and

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conduct experiments upon that section of track, placing it under such supervision as will insure the keeping of proper records. The Santa Fe had such a track in the vicinity of Somerville, Texas, a place that was not at all favorably suited to the longevity of timber. The usual untreated timber rotted very fast, and its officers have derived great benefit from their observation of the results they have obtained in that 5-mile section.

If timber is subjected to mechanical wear, as is the case in the greater number of uses to which it is put in connection with the railroads, it is not only indispensable to its economical use that it should be thoroughly impregnated or treated but also that it be protected against mechanical wear which may cause its destruction within a period much shorter than that of its natural durability even if untreated.

While we have some scores perhaps of treating plants, in fact, I believe there are now 140 in this country, instead of 20 or so as in 1905, and while millions and millions of cross ties are being treated and inserted in the tracks of our railroads annually, the criticism to which we were subjected by the foreign delegates to the International Railway Congress in 1905 still attaches. Those delegates were appalled by our great wastefulness in putting perfectly good timber in tracks and adopting no means whatsoever for its protection. That is a criticism that generally attaches to the processes that are adopted by us as a nation and which were voiced by the visiting Belgian Commission last summer while they were in Chicago. In traveling from New York to Chicago they were overwhelmed by surprise on account of the large amount of waste land and of the immense amount of timber that was used for fencing the land and the fact that it seemed to be the standard practice to store farm machinery outdoors, also a great many other things of that kind that are of common knowledge among us, and in no sense have we sinned more flagrantly and more obviously than we have done and are still doing with reference to the maintenance of our railroad tracks. The subject has been considered of sufficient importance to have been adopted as a plank in our political platform.

I refer to the matter of conservation, and a sufficient number of consumers of lumber have taken enough interest in it to have caused the erection of six or seven times as many treating plants as existed in 1905, and out of this movement, or rather included in it, has come this splendid Association.

Still we are treating timber and subjecting it to certain uses under conditions which absolutely insure that the treatment is wasted; whatever is spent for the treatment is absolutely wasted like so much money thrown into the fire.

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No nation has had greater experience than ours in the use of timber. No nation has more fully determined all of its characteristics. Having an abundance of timber it was used for all manner of purposes. Until 50 years ago or so all of our railroad and other bridges were constructed of timber, and it is only within my experience as an engineer, which is now becoming rather long (the shadows are lengthening), that steel has come into use. My earlier experience with metallic structures was based upon the use of iron, and we have made thousands and hundreds of thousands of tests for the purpose of determining the strength of timber under different conditions, and yet when we use it for certain purposes in its use we have adopted means that were palpably inadequate, and it should have been perfectly evident to the veriest tyro that the protective agencies adopted were entirely insufficient for the accomplishment of the purpose that it was expected to accomplish, and indeed many of those agencies were absolutely destructive. Yet we have used them and we continue to use them, the great bane of our practice being the undue weight given to the matter of first cost. If a thing is a little cheaper than another thing, whether it is in tie-plates or something else, that fact appeals to a great many people, the larger proportion, and the ultimate goal that we are seeking is lost sight of entirely in the interest of this cheese-paring process and for the benefit of the showing that can be made for the moment those things are purchased which can be purchased for the least amount of money. If anyone gives a thought, or makes a protest, against the wastefulness of that process it is certainly without avail.

Of course, we are improving. Some of the roads, many of them have come to the conclusion that there is no use in treating a perfectly good tie and spending a considerable amount of money for that purpose and then putting it into the track and wantonly destroying it within four years, whereas if it was properly treated and protected it might reasonably be expected to last from 16 to 20 years.

Under the traffic conditions that govern when our rails are renewed from time to time it is impracticable for us to insert the tie-plates, that is, under our existing practices, until after the new rails are laid. Oftentimes the pattern of the rails is changed. The ties are invariably rail cut. They must be adzed (or mutilated) to receive the new rails and the rails must be tacked on, as it is called, in order to insure continuity of route and permit the passage of trains. That is accomplished by the use of cut spikes. Later a section gang goes along and pulls these spikes and plugs the holes and inserts the tie-plates and drives some more spikes, so that with respect to those ties in which spikes were driven originally to hold the rails for the maintenance of traffic during the process of renewal, upon which tie-plates are subsequently placed, there are certainly four holes, two of which are more or less perfectly filled by plugs and the others by the

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spikes. But the timber is cut and splintered, and moisture has easy access to the interior of the tie.

We all know that it often happens, especially if the timber is good, that only the exterior is treated and the interior is untreated and decay is set up within the tie, with the result that in a period, perhaps no longer than would have run if the tie had not been treated, it must be removed from the track, because of interior decay.

So our methods are in my judgment both deficient and exceedingly inefficient. Personally, I believe that so much stress has been laid upon getting a thorough impregnation and upon the virtues of the softer varieties of wood, because they will absorb creosote or other preservatives that we have gone too far in that direction. I know that within the past few years certain woods are admitted to specifications as preferred woods which during my earlier practice were absolutely proscribed and excluded, would not be thought of. In the endeavor to get cross ties which cost less per tie various indulgences, so to speak, have been allowed, so that on certain roads in regions which are nearly denuded of timber one may find cross ties and will find plenty of cross ties in tracks that are not more than 4 or 5 ins. in width, and there they serve to support the rails in some way in defiance of all physical laws, but, nevertheless, they do serve a purpose temporarily.

It seems to me that if one is to spend a great deal of money for the preservation of the tie it should be worth preserving in the first place. There are some things that are not worth preserving. There are some kinds of wood that are so fragile when they are put into the tracks even though they may be par excellence so far as the absorption of preservative is concerned, if they could be kept as samples of how excellently they do absorb the preservative and were not to put into practical use they would be very fine, but after being put in track if there is any center binding they break. They are too fragile for the purpose for which they are intended. If you happen to have a derailment at a place where a great many of those ties come together there is nothing left of them, so that I do not see why we should not change our practice. I can understand why we should use that wood when it can be used to advantage, but I do not see why we would not do well to follow a course similar to that pursued in Europe, where they do use sound wood. You will find hewn ties in France and in Germany and in England you usually find dimension ties, ties that come from Norway. By the way, I was surprised to find in England on the London & Southwestern Road that they treated ties by immersion in creosote. They had appropriated a sum of money for a treating plant, but there were other uses which seemed to them to be more important which required money, so they still continued the

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treatment of ties by immersion which only extended through a few hours. The ties were put into a vat during some portion of the day and the creosote was turned on and in the morning it was drawn off and the ties were taken out, and I was really surprised at the penetration that was revealed by a cross-sawing of some of those ties. It would have been considered satisfactory in many cases of treatment under pressure in this country. The timber was Norway pine, that is, the pine came from Norway. Of course, it must have been relatively coarse-grained, otherwise it could not have been penetrated in that way by the creosote.

I made a special effort to find a place in England where they were going to renew some track, as I wanted to see the process, and on all the London & Southwestern Road I found there was a section of track about a mile in length that they were going to take out and renew the next Sunday. That track had been in place for 14 years. Upon going to the ground I found the new ties and the rails all assembled and in place. They used the large cast iron chair which is fastened to the ties put on at the material yard. The rails are seated in the chair on the work beside the track and are wedged to gauge by oaken wedges. That track had been in service for 14 years, and personally I could see no reason why the ties should have been replaced. I presume they may have been used somewhere else eventually. They seemed to be perfectly sound, and were not cut. They were spaced, fully 2 ft. apart in the clear. Of course, their wheel loads are comparatively light, that is, compared with the American standard.

Now then, it is a very common thing, as you all know, to treat timber and then as a part of its incorporation in the work, as one of the processes, to cut it, to bore it, to adze it and to destroy the outer coat, that portion of treatment that is on the exterior of the wood and which in certain woods is all that you have, because the preservative will not penetrate the interior. That is a very prevalent practice as far as cross ties are concerned.

In 1907 75% of all the cross ties that went into the tracks of the American railroads were hewn. It is almost impossible to give a tie-plate a proper bearing upon a tie unless it is sized or adzed. We all know, as I have stated and restated, that the fibers of the wood are destroyed by driving the spikes into them. Therefore, it would seem natural and proper and something which should impress itself upon the minds of everyone that all of this work should be done at the treating plant before the ties are treated and that these points which are the most vulnerable should be treated with as thorough an impregnation as possible. Of course, that will be furthered very greatly if these holes are bored and if the adzing is done before treatment.

I am aware that the purposes of this Association and its representation by members cover a great many other things beside cross ties,

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but I talk about cross ties, because after all that is the largest use for treated timber, and I believe that as the campaign for the treatment of cross ties, which has been very thoroughly launched and is under strong headway, (as all of the other forms of treatment or purposes of treatment are in a sense, correlated with it), achieves success, and is recognized as an economic principle by the people who have to furnish the money or who are affected by the expenditure that is made on its account, the treatment of timber for all purposes will be stimulated. So that in talking about cross ties I do it for two reasons; one is because I think it is the most important branch of the science today and the other is because it is a subject that I know more about than I do about the others.

I believe that ties should be made of better timber. I believe they should be larger. I believe that the returns to any company that adopts better tie specifications will be sufficient to warrant the larger initial expenditure that may be made. Of course, if the ties are larger fewer will be used per mile and you cannot expect to secure durability and satisfactory results unless you start with a good foundation as to material.

We in this country still cling to cut spikes for cross ties. Screw spikes have been used to a limited extent. It is generally considered that their cost is prohibitive. It is further considered for some reason that I cannot conceive that their use is experimental. They have been used for 50 years abroad, and with entire success.

It is true that our wheel loads are heavier, and it is also true that we use more ties per mile, and in my judgment there is no earthly reason why we should not use screw spikes not as an experiment, because they have been amply proved, because they have been approved as a form of fastening unless we take a leaf from English practice and use a round dowel or spike, which may be likened to a blank rivet. The English practice consists of pressing into the wood or driving into the wood ferrules or dowels made of oak. They are driven in holes slightly smaller than the ferrules, or dowels, and, consequently, make a very tight fit. These dowels in turn are pierced by a center hole to receive the spikes. These are smaller than the spikes which are driven with considerable difficulty, that is, friction offers considerable resistance to the driving of the spikes. I found that it took eight blows of a strong man to drive them home under the practice that I observed in England. I had a curiosity to know what force would be required to remove the chairs. I asked, how much of a job it would be to get those chairs off? How much resistance do these spikes oppose to withdrawal when you want to withdraw them? I found that it took four men with pinch-bars about 10 minutes to pry a chair from the tie.

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That seemed to be a rather promising indication, so within the past two years I have had some experiments made at the University of Illinois, and I have found in a general way that a screw spike would withstand from 8,000 to 9,000 lbs. before it gave way, and then, of course, after that it was no better, or not as good, perhaps, as a cut spike. I found that a round spike driven in a round hole in an oak trenail or plug, required about 3,000 lbs. for its removal the first time, the second time about 4,000 lbs., but for twenty odd repititions of the pulling of that spike the frictional resistance was not materially reduced. It took the twentieth time that it was withdrawn as much force to pull it from the plug as on the first occasion, so it seemed to me that its use is worthy of consideration because that instrumentality costs far less than a screw spike and is sufficiently efficacious. I cannot think that there will be any upward force tending to withdraw that spike which will amount to 8,000 lbs., and two of them would have an ultimate value of 8,000 lbs. in the matter of holding the rails down.

I think a great many of the accidents that are referred to as caused by the spreading of rails are due to the barbarous and imperfect manner of spiking. Anyone walking along the railroad track will observe that the majority of the spikes have no bearing upon the rail. I think the spread-rail accidents are very largely caused in the first place by a faulty brakebeam and consequent derailment and absolute inability of the rails to withstand overturning on account of the fact that the spikes have no holding value. The principal thing that they do is to destroy the cross ties.

The number of cross ties that is being used I referred to earlier in my remarks. It is constantly increasing and the expense that attends the maintenance of a supply of cross ties is becoming ever more onerous. Of course, we have periods in which timber becomes a drug on the market and mills are idle. People having standing timber must convert it into money for their current necessities, and there are recessions in prices which are so striking as to have some reflex effect upon the matter of treatment. It is a question with a good many whether after all it is worth while to treat timber because what has been prophesied has not come to pass. The cost of timber and ties is less than has been predicted and so it has a deterrent influence; in fact I know of some roads that have abandoned treatment, at least for the time being because they can get untreated ties so cheaply.

It seems to me that is the way in which it should be considered, because ultimately whether people think so now or not, I mean the layman, ultimately it will be necessary to treat ties. They cannot afford to do otherwise, because ties are going to cost more than a dollar, and the cost of a dollar apiece has been realized in a number

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of cases in the east and in some cases in the west. I know the Santa Fe imported some ties that cost over a dollar apiece in track. If the life of these ties can be doubled, if the timber in untreated form would last seven or eight years, and if treated would last from 14 to 16 years or longer, then it should certainly be expected that if the ties are inserted as they are required for renewal year by year that after seven or eight years there will be a long period during which there will be comparatively few to put in.

The mileage of the steam railroads of the United States in 1913 was about 387,000, and deducting the ties used for 8,700 miles of new track, and by trolley lines, the total number used for renewal purposes by steam railroads was about 114,000,000, and the average life of the ties replaced was a little in excess of seven years. The cost of ties in track was about 85 cents each. The total number of cross ties in railroad tracks was about 968,000,000, and the average annual cost of ties on the basis of life of 7.3 years is approximately $170,000,000, so that the subject becomes a very large one. If the number of ties for renewal purposes next year be cut in two, and if we can assume the cost of the ties to be from 80c. to $1.00 apiece, then it might be said in round numbers that the nation would save, the users would save from $80,000,000 to $100,000,000 a year during that year and afterwards. That, of course, is very impressive, and it is only by bringing these figures together and making them national that they become sufficiently so to attract any special notice. They are important with respect to any large railway system; to a small railway system they are not particularly important.

I mention this for the purpose of coming up to this phase of the matter. I believe in order to make substantial and satisfactory progress in the movement in which we are all interested that it is necessary to show economical progress. Everything after all which is called economic must be given a money value if it can be found. The trouble about the preservation of timber is that if timber unpreserved will last 15 or 20 years for certain uses, and will last 50 when it is treated, that the people who treat that timber are very seldom on the scene at the expiration of the 50 years to call attention to the merits of the process that was adopted, and it requires a prophecy and some processes of reasoning, some vitalization of the subject and the presentation of facts in order to impress upon the minds of the people who furnish the money, and who desire to save money, the people who own great properties, because the great properties are the ones that are most largely interested in this subject, that this really will be an economical or profitable thing for them to do.

Now, cross ties as an item of railroad accounting appears as an item of cross ties, and not in conjunction with any expression of the

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number of ties that are being used. The cost stated is, of course, affected by varying prices, and by other considerations so that it does not attract anyone's attention. It appears under the Interstate Commerce Commission classification of accounts as cross ties, and being very much interested in this problem of treatment, and having a desire at various times to use it in my discussions of possible economies in connection with certain properties, I have endeavored to get information as to the experience of the roads that had used treated ties and timbers most largely. I have found in all cases that on account of the addition of mileage, either by construction or through the purchase of lines, and on account of the discovery of the fact that the original conception as to their form of records was not a fortunate or happy one, and on the account of a lack of foresight in the matter of the protection of the timber, and for sundry and divers reasons, that there is no such thing as attractive or convincing information with respect to this all-important matter.

Now, to illustrate what I mean by giving this information in such form as to command attention, we will take the matter of loss and damage freight. That appears under the item of Transportation in Interstate Commerce Commission accounts as a segregated item. It stands there in dollars and cents. It is item 418 of the Interstate Commerce Commission accounts. As equipment grew older, and as the business of the roads grew larger, and their terminal facilities became somewhat overcrowded, loss and damage commenced to mount until it assumed extraordinary proportions, so that some years ago it was forced with especial emphasis upon the consideration of managers of railroad companies, and, generally speaking, it may be said in this section of the country that it amounted to over 2% of the freight earnings of the roads, in some cases 2.5%, or even 3%. It is manifest that if a road is doing $60,000,000 worth of freight business a year that 2.5% is a very substantial and respectable sum, and is entitled to the greatest consideration that can be given it. It is a heart-rending task to reduce loss and damage freight claims. It takes a good deal of time, but year by year that item appears in the accounts of the railroads in the annual reports as so much money. Now, then, if the earnings are going up, and that is the natural trend of freight earnings, and if loss and damage claims are coming down, and that is manifested by an absolute lowering in these accounts or in these reports year by year, it attracts public attention. It attracts everyone's attention who is interested in the matter, and it is a fact that within the past five or six years certain of the railroads of the West have succeeded in reducing this element of cost so that it is less than 1%. Calling it 1%, and still calling the freight earnings $60,000,000, it is apparent that the loss and damage amounts to $600,000, whereas formerly it was $1,500,000, which means a saving of $900,000, and the direct cost of the organization which affected that

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probably is $25,000 to $30,000. It is evident to everyone that is a very profitable undertaking.

You see how different it is from the element of accounting, or the method of accounting with respect to cross ties. Here is an ever-changing condition of affairs, because of the addition of mileage, of increased traffic in tons that passes over the tracks, and with respect to records because of possible changes in the management, so one gets the most surprising statements about the longevity of cross ties under various conditions. I am told on certain roads that their cross ties without treatment last 18 years, and also receive very extraordinary statements about the longevity of treated ties, so that I have come to feel that there is no dependence to be placed upon such statements.

Going back to the time when I was chief engineer of a railroad, and even before that time, when I personally made inspection of bridges, and knowing that the life of a timber bridge was from 8 to 12 or 13 years, and being told now that important timber structures last 22 years, untreated timber—well, they may last, but they certainly do not carry much traffic.

In my judgment it is important for this Association, and for the railroads and other users of treated material, that records should be established which will express and prove as far as records may and can what has been accomplished through and on account of the preservation of timber, both in years of added durability or service and in the saving that has been effected; and more especially the reports should reflect the saving that has been effected. Now, everyone who has essayed to establish a record beginning when the art or science was new, to make a record which would reflect the conditions that obtained from year to year, knows it is a very difficult thing to do, and after they have gone on for a few years they find they wish they had done something else.

I venture to suggest that in my judgment this Association should set up standard forms of reports to be used by all railroads that use treated cross ties, and that these forms should show for each year the miles of main track, the number of ties in main track, the miles of sidings and yard tracks, the number of ties in same, the number of treated ties in each class of track, the number of ties inserted for renewals in each, the number that would have been required on the basis of renewals of a certain year at the time the use of treated material was started or before, and the increase or decrease in the number of ties and the value of ties in the track at current cost. So that if you used a million ties less this year for a certain piece of track than you would have done under the conditions that obtained six years ago or so, and if those ties are worth 80c. apiece in track in that region, you would have reason to believe that you had saved $800,000 that you would not

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have saved if you had gone on using untreated material. Then I think that the mileage applied to roads should be divided so as to show sections subject to different climatic conditions separately; also for the purpose of keeping notes of old lines, separate accounts of lines that have been maintained for years from those that are newly built or have been recently acquired. Of course, these are merely suggestions. I realize that starting with any basis there would be numerous amplifications necessary, but preservation costs a good deal of money, and after all you have got to wait a considerable term of years before you can absolutely determine its efficiency. Therefore, it should be of the best, and the facts can only be determined by the maintenance of proper records. Those records (and I wish to emphasize this) should be shaped for the purpose of showing what has been accomplished in the saving of dollars and cents, as well as in the increased durability of timber measured in years.

There are a great many uses to which treated timber is put in which its durability is so great and it lasts so long a time that it would hardly seem that any records with respect to it would be of much interest except scientifically. There is no use to which treated timber has been put in structures that has not been of great interest to me. About two years ago I had occasion to examine the line of a very long railroad system which had a great deal of timber trestle, and, of course, a certain percentage of it could be filled economically, and then came a question as to what kind of structures to use upon the balance. I desired to know the experience of the Louisville and Nashville Road, which was the pioneer in the use of creosoted ballast deck structures. It was predicted that these would last for 25 years. Well, they have lasted more than 25 years on that road, and are apparently, or were at that time, as good as ever. So it would seem that that practice should be more generally adopted, and it has been. I can see no reason why it is not just as good as or better in many respects than a metallic structure, especially if the latter has open floors, and with respect to structures of that kind it may be possible and practicable to originate records, and keep them up for the purpose of showing the saving that has been made by their use.

Before leaving this subject of cross ties and other similar things, if a tie-plate can be devised that can be applied to the cross ties at treating plant or at material yards so that we can be assured that the work will be perfectly done, and that the plates will have perfect bearings, and will be securely fastened to each tie, a great deal will have been accomplished in the way of the prolongation of the life of ties. Going before that is, of course, the matter of the design of a proper tie-plate, and that is one of the reasons why I make a plea for ties of more generous proportions rather than those of less generous propor-

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tions. It is a serious problem to get a sufficient bearing surface for the proper distribution of the load that is transmitted by the rails to the ties through the medium of the tie-plates, and if they are made of sufficient area to transmit these loads reasonably well, then they must also be made of sufficient thickness so that they may not buckle, and yet in most of the tie-plates, or in many of those that are in existence today, or have been used during recent years, you will find various expedients have been adopted for the purpose of lightening them, such as rotting, shallow channels, which, in my judgment, is very bad practice.

Then it is usually considered desirable to have a stiff rail, because it reduces the wave action. There is a sentimental leaning towards heavier rails. It is a good sentiment, because heavier power requires the use of heavier rails, which diminish wave action, and consequently the resistance that is opposed to engines, but the rail also has another mission to fulfill. It is probably impracticable to devise a tie-plate on a tie of reasonable size which will distribute the pressure to which the rail is subjected if it is supposed to rest only upon that tie to a sufficient extent to avoid crushing the fibers of the wood and destroying the tie. One of the most important services of the rails should be to distribute the load over several ties, in which case it is within the bounds of possibility to design a tie-plate which will, in fact, protect the tie.

If all these things are done, I can see no reason why ties should not last as long as they do abroad. I can see no reason why we could not in time produce from our tracks samples of cross ties that have been in track twenty odd years, or 26 years, as was the case with the Paris, Lyons and the Mediterranean Road. They have plenty of them 26 years old, and they are afterwards usable for a variety of purposes.

I have been interested in scanning somewhat hastily the papers that have been presented to this Association, and particularly so in the paper about telegraph poles and piles, and the practicability which is prophesied, or announced, of butt-treating them, so the portion that does not require preservation need not be treated at great cost, and that portion that does will be adequately protected. This is something that I have thought a great deal about in the past few years, and it has appealed to me as something which should be practicable, and I am glad to know that the problem seems to be in a fair way to be solved.

In regard to what is perhaps second only to ties in importance, at least perspectively, and perhaps at the present time is the matter of the conservation of wood intended for paving blocks. According to my own observation, and according to my brief reading of the paper upon that subject, the trouble here again is not so much a matter of the conservation of the timber against decay as it is to secure its use under proper conditions and specifications so that it may not be destroyed from other causes.

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So that to sum up we have to consider not only the proper treatment of the timber by whatever process may be adopted, but the exertion of influence with respect to its proper use and with all, and perhaps above all, ultimately to establish the measure of the value of that treatment expressed in dollars and cents (applause).

THE PRESIDENT: Mr. Kendrick, in behalf of the American Wood-Preservers' Association I want to thank you for giving your time to us this morning.

The President then read his address as follows:

PRESIDENT'S ADDRESS.

To the Members of the American Wood-Preservers' Association:

Your Constitution provides that the President shall deliver an address at the Annual Convention so that it is not necessary for me to apologize for this address. I am simply obeying your orders. I do not want you to think for a minute that I do not appreciate the honor you conferred on me when you elected me President. It is an honor which any member of the Association ought to appreciate.

Your Constitution also provides for an Executive Committee of eleven. "This Committee to have entire jurisdiction over the affairs of the Association, to appoint the committees, to have entire responsibility for the government of the Association."

I am quoting this so that none of you will make the mistake, if this Convention is a success, (and it will be) of giving the credit to the President, for it rightfully belongs to the Executive Committee and the Committees which they have appointed and the work which they have accomplished.

Your President appreciates the hearty support not only of the Executive Committee but of each member of the Standing Committees and of the gentlemen who have so willingly furnished the valuable papers which will be read before this Association.

In the President's address I take it that you would like to have his viewpoint as to what ought to be done to advance the best interests of the Association, and while all of you may not agree with me, I trust some of you will and that some of the things I suggest you will put into effect.

Research Committee.

I have long felt that we are failing of our opportunity and the obligations which are placed upon us by the stand that this Association has taken when a new idea has been placed before the Association along the lines of wood preservation, and for that reason I suggest that we

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appoint a committee, known as a Research Committee whose duty it will be to investigate any patents which may be referred to this Association, that the Association may have the benefit of the best minds in the Association and their opinions on any matters which may be referred to them.

It ought not to be the rule to stamp out, blue pencil or crush in one way or another, ideas which varied from what we might call normal standards. Many members of the Association, in order to meet the propositions which have been presented to this Association, have had to write pages to their officials, explaining the reason why certain processes cannot be adopted.

Within the past few months a gentleman from Washington has written several of the Presidents and operating officers of various railroads in this country presenting a new scheme and a new idea for treating material.

Many of us feel that it is of no value, but if we could refer this to a Research Committee, and they could pass on it, when we were questioned by our officers as to what our opinion is, we could not only give our opinion, but we could back it up by the Committee which I have referred to.

I would like to see Mr. Howard F. Weiss made Chairman of this Committee and four other members whose standing would give weight to their opinion, and in future we should invite new propositions and let this Committee investigate them thoroughly and give us the benefit of their work.

Commercialism.

I would call your attention to the fact that there is one thing above everything else we should guard against and that is commercialism. The American Wood-Preservers' Association should be too big and too broad to be commercialized. It should be all its Constitution suggests when it says: "The objects and purposes of the Association shall be to advance the wood-preserving industry in all its branches."

There are various methods of preserving timber, many of which if thoroughly done will not only lengthen the life of the timber but will pay fourfold for the amount expended for the same, and the field is big enough and broad enough for all to work in.

It is our duty as an Association to bring to light or rather to throw all the light we possibly can on the various methods used and we need not worry, the future will take care of itself. It will be a survival of the best method in the end.

The treatment which gives good service in the dry climate of the Middle West might not be practical at all East of the Missouri River,

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and if I understand our duties, it is up to this Association to gather information which will be reliable and can be disseminated throughout the country so that the people using treated material can have the benefit of our knowledge and experience.

Facts, Service Tests, Results Obtained.

Some of us object to the word "Facts." You will note in our program this year instead of using the word "Facts" we use the term "Service Tests."

In consulting various members of the Association, some think we ought to have used the term "Results Obtained" and still others say that "Facts," "Service Tests," "Results Obtained" should be referred to a Statistical Committee, and all we want is statistics.

I, for one positively object and will object as long as I have a voice in this Association, referring "Facts," "Service Tests," "Results Obtained" or whatever else you may call it, to a Statistical Committee, because the moment you do that, you will lose what we are attempting to accomplish.

Few practical men will spend any time on statistics. They do not like the word. One prominent railroad man speaking about this said: "There are lies, damn lies and statistics," and so I trust that the Executive Committee, who have control of the affairs of the Association, will see to it that our "Service Tests" are continued.

I do not think that I am exaggerating it at all when I say that 95% of all the material treated is used by the railroads of this country. If that is true then 95% of the expense of this Convention is paid directly or indirectly by the railroads of this country.

Further, then the railroads of this country have a right to information which will be of value to them and what do they want? What do the officers, who are responsible for the expense and operation of our railroads in this country, want?

They want to know the best methods for preserving their ties and timber and they also want the "Facts," "Service Tests," "Results Obtained" from the various methods in preserving the timber.

It is absurd for a committee to get together and write a report in an office on theory. The day is past when you can put up to our American people what has been done in France, Germany and England with treated timber.

We have been treating timber long enough in this country to be able to go before the operating officers of any railroad and give them positive information as to what they may expect when their timber is properly treated.

Are we doing it?

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Look through the Proceedings of the American Wood-Preservers' Association for the past twelve years. How many pages cover "Facts," "Service Tests," "Results Obtained"?

Gentlemen, it is up to you. What are you going to do about it?

Constitution and By-Laws.

Change is synonymous with development. When we wish to describe things which have remained unchanged we generally say they have stood still. The American Wood-Preservers' Association has certainly not remained stationary. It has outgrown the clothes in which it was christened, and those of us who have had to administer its affairs within the bounds of its constitutional requirements have felt that they did not quite fit the growing body that we are.

Our Constitution has been amended in the past, though with a seemingly too great regard for its original form and phraseology. The result has been a somewhat involved and verbose collection of laws to control our actions.

To meet the wishes of members who have spoken to me of this matter, I asked a member of the Executive Committee to recast our Constitution in a form which would be more fitting to the adult state of our organization.

You have had the proposed Constitution to compare with our present bill-of-rights, and when the matter is under discussion, I hope every member will contribute toward providing us with such by-laws as will enable us to develop properly.

The Probate Member seems to be the answer to the idea many of us have had regarding the increase of membership. This class of member furnishes revenue to the Association, gives an interest in its work to those who are engaged along the lines of its activities, and it gives them an incentive to render good service to their employers through wishing to receive the standing which their promotion to Corporate Membership would provide.

The present provision for the payment of dues by members admitted during the second six months of the fiscal year has been of particular annoyance. I think it is absurd to admit men to the Association and make them pay the annual dues for months that are passed when they get little or no benefit from it. In fact if I had my way, after the Convention closes I would simply have the initiation fee and the dues begin the next Annual Meeting. I think we would find it would work better and we could reach more members and the Association would be more successful in getting in new members.

The new provision regarding the election instead of the appointment of the Nominating Committee is a step toward making our As-

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sociation the democratic body it should be. It is a good thing. It takes out of the President's hands a very embarrassing situation in appointing a Nominating Committee, and it tends to prevent a clique getting in control of the Association and perpetuating themselves through the officers whom they may nominate.

Wood-Preserving.

When we resolved last year that our quarterly publication be continued, I had no idea that we should see four issues as worthy of the praise given them on every hand as have been those constituting Volume 2 of WOOD-PRESERVING. When I think of what a few members of the Association have accomplished in developing our medium of intercourse during the year, I wonder what WOOD-PRESERVING would develop into if our general membership would contribute to it as loyally as they have.

Manual.

One of the brightest engineers in our Association has several times brought before this Convention the needs of a "Manual on Recommended Practice of Wood-Preserving." I not only heartily endorse his suggestion, but this Association approved the following resolution at the 1915 Convention:

> That the officers of the American Wood-Preservers' Association during 1915 make such arrangements as will result in definite steps toward the preparation of a "Manual on Wood-Preserving."

I am sorry to say that in the past year nothing has been done and no steps taken. I earnestly request that the officers of this Association in 1916 will take definite steps to carry out the instructions of this Convention, and I would recommend for Chairman of that committee Mr. M. K. Trumbull.

Officers of the Association.

The officers of this Association should be carefully selected. However, I see no reason why your President should always be a railroad man, but I do see a reason why a majority at least of your Executive Committee should be railroad men, and it is not necessary for me to go into details as to why, for I think I have covered that point very thoroughly above.

Our Secretary.

You will note I use the term "Our Secretary."

Why? I have read carefully the addresses of your Presidents from 1910 to date, and I find that everyone of them uses the most flattering terms in speaking of his work.

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He has been Secretary and Treasurer of this Association for six years. In six years the Association has expanded and grown beyond the expectations of any member of the Association.

The highest compliment that I can pay him is to quote the words of our Ninth President, Mr. E. A. Sterling, in his annual address to this Association. This is what he said:

> By right the Secretary should make the welcoming address and advise you of the progress of the Association during the past year, because he has done most of the hard work, and to him belongs the glory of our accomplishments.

What was true then is true now, and we should be very careful and give the matter very serious consideration before we think for a moment of changing the Secretary. We are getting the knowledge and experience of a man who is worth four or five times to this Association what we pay him, and I certainly would recommend that we increase the amount of his allowance, in order that he may be able to hire efficient help to conduct the ordinary run of work in his office, and he superintend the same.

Before closing this address I want to thank you gentlemen for your presence and co-operation. I shall try to rule the Convention justly and ask you for your hearty support. Please remember that the Convention is bigger than any President, and that your wish is my pleasure.

This Convention is indebted to Mr. J. B. Card for his untiring work the past year as Chairman of the Program Committee. It is through his efforts and staying qualities that we are able to present you with the splendid program which is before you.

I also want to thank not only the Chairmen of the various Standing Committees, but each member for their work during the past year, especially the work of our Entertainment Committee, for their most excellent work in bringing to this Convention at least two men of national reputation, and I am sure when we adjourn their work will have been so thorough and complete that we will feel like giving them a rising vote of thanks.

Gentlemen, I thank you.

THE PRESIDENT: The next business before the Convention is the approval of the minutes of the last Convention. The minutes have been circulated; you have all had them in your homes. If there is no objection they stand approved. I hear no objection; they are approved.

The next will be the Secretary-Treasurer's report.

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ANNUAL REPORT OF THE SECRETARY-TREASURER.

To the Members of the American Wood-Preservers' Association:

GENTLEMEN: Your Secretary-Treasurer begs to submit herewith his annual report for the year 1915:

Cash on hand December 31, 1914		$737.16
RECEIPTS.		
Initiation fees	$386.00	
Membership dues	2,509.60	
Advertising—Proceedings	1,141.73	
Advertising—Wood-Preserving	697.47	
Subscriptions Wood-Preserving	135.00	
Sales of Proceedings	234.95	
Interest on bank deposits	37.89	
		5,142.64
Total cash balance and receipts		$5,879.80
DISBURSEMENTS.		
Reporting and printing 1915 Proceedings	$2,053.70	
Postage, expressage and telegrams	325.97	
Office supplies, stationery, printing, clerical and stenographic work	1,168.80	
Expense incurred at 1915 Meeting	211.88	
Printing program, invitations and badges	113.28	
Subscriptions to periodicals	24.50	
Membership certificates	11.85	
Expenses of Committees	19.15	
Contribution to Forest Products Federation	25.00	
Membership Chamber of Commerce	15.00	
Expenses of "Wood-Preserving"	1,144.27	
		5,113.40
Cash on hand December 31, 1915		$766.40

Detail Statement of WOOD-PRESERVING

RECEIPTS.		
Subscriptions	$129.00	
Advertising for 1915 paid	454.48	
Advertising for 1915 outstanding	169.41	
		$752.89
DISBURSEMENTS.		
Printing (four issues)	$720.96	
Salary, Managing Editor	250.00	
Salary, Stenographer	60.00	
Postage	52.16	
Stationery and printing	61.15	
		1,144.27
Deficit		$391.38

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Membership.

Number of members last annual report			265
Number of members elected during 1915		29	
Number of members resigned		7	
Number of members dropped		8	
Number of members deceased		3	18
Total net gain			11
Number of members in good standing Dec. 31, 1915			276
Number of Corporate Members	221	or	80.1%
Number of Associate Members	48	or	17.4%
Number of Honorary Members	4	or	1.4%
Number of Junior Members	3	or	1.1%
Total Membership	276		

Growth of Membership.

Year	New Members	Withdrew	Added to Roll	Total
1904	20	..	20	20
1905	7	..	7	27
1906	9	7	2	29
1907	15	..	15	44
1908	5	4	1	45
1909	13	12	1	46
1910	29	8	21	67
1911	45	8	37	104
1912	59	6	53	157
1913	37	11	26	183
1914	92	10	82	265
1915	29	18	11	276
Total	360	84	276	276
Average for 12 years	30	7	23	

Distribution of Members.

		Members
39	Railroads	74
46	Commercial treating plants	99
12	Tie and lumber companies	12
21	Chemical and manufacturing companies	31
2	Periodicals	2
3	Associations	5
3	Educational Institutions	5
9	Firms not classified	9
4	Municipalities	4
	Individuals not classified	4
	Consulting engineers, chemists, etc	25
	United States Forest Service	5
	Libraries	1
	Total	276

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Geographical Distribution of Membership.

STATE.	1913	1914	1915
Alabama	3	4	3
Arkansas	4	5	4
California	4	5	6
Colorado	0	3	2
Connecticut	1	1	1
District of Columbia	0	4	4
Florida	4	4	3
Georgia	3	2	5
Illinois	27	35	41
Indiana	5	6	8
Iowa	1	2	1
Kansas	1	4	4
Kentucky	3	7	8
Louisiana	8	10	12
Maryland	6	5	5
Massachusetts	1	2	3
Michigan	3	2	3
Minnesota	10	9	10
Mississippi	3	3	3
Missouri	8	12	12
New Jersey	3	7	6
New Mexico	2	3	3
New York	11	21	24
North Carolina	0	0	1
Ohio	11	11	12
Oregon	4	7	5
Pennsylvania	9	14	12
Tennessee	1	3	2
Texas	13	17	13
Virginia	3	3	3
Washington	9	16	17
West Virginia	2	2	3
Wisconsin	6	8	9
Wyoming	1	3	3
	170	240	251
FOREIGN.			
Austria	1	1	1
Canada	8	14	13
England	2	4	4
Germany	2	6	6
India	..	..	1
	183	265	276

A word may be said about our publications—The Annual Proceedings and quarterly journal, WOOD-PRESERVING—as they are the means through which our Association is endeavoring to advance the timber-treating industry in all its branches, and make known the principles upon which our organization has been founded. Both publications are attracting increased attention, and are the means of interesting the public in our Association and of encouraging new memberships.

Respectfully submitted,

(Signed) F. J. ANGIER,
Secretary-Treasurer.

THE PRESIDENT: You have heard the Secretary-Treasurer's report. What is your pleasure?

L. B. MOSES: I move the adoption of the report.

F. D. MATTOS: I second the motion.

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THE PRESIDENT: You have heard the motion to adopt the report of the Secretary-Treasurer. Has anyone anything to say on it? If not, those in favor say Aye. The Ayes have it.

Mr. Secretary, communications.

(The Secretary then read a telegram from Mr. R. L. Allardyce, from Texarkana, Ark., expressing regret that he was unable to attend the meeting, and voting for New York for the next meeting place).

THE SECRETARY: We have received a great number of letters in response to our invitation. I will not take the time to read them.

THE PRESIDENT: The Secretary has one or two things that the Executive Committee will have to pass upon, and I would like to announce that there will be a meeting of the Executive Committee at my left just as soon as we adjourn. There are one or two papers that want to come before the Executive Committee to rule on. It will take us only a very few minutes.

The next order of business is the appointment of special committees. I have appointed our friend, E. T. Howson as press agent (applause), so if you want to get your name in the paper go around and see Brother Howson.

Auditing Committee: The Auditing Committee must be appointed, as I understand our by-laws, from the Executive Committee, so I have appointed John Foley and C. M. Taylor.

Resolutions Committee: L. B. Moses (Chairman), G. M. Davidson, A. L. Kuehn, Charles C. Schnatterbeck.

Memorial Committee: S. D. Cooper (Chairman), A. C. Scholtz, E. J. Roth.

Nominating Committee: R. Van Metre (Chairman), J. B. Card, G. L. Pollock, T. D. Mattos, O. C. Steinmeyer.

What further is to come before the meeting before we adjourn?

THE SECRETARY: The report of the Entertainment Committee.

THE PRESIDENT: Yes. I hope Mr. Joyce will not be too modest, and at the close of every session that he will come forward and tell us what he has to say.

MR. A. R. JOYCE: The blue cards have been distributed, and they outline the entertainment for the ladies. You will note that this afternoon at 2:30 the ladies will start for the Chicago Historical Society. They have a lot of bird writing over there. I do not know whether the ladies can read it or not. It is on elk skins and other

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things that the Indians used to write on. There is a door of a cabin that Columbus used to live in, and a lot of other things that are interesting. This has been arranged through the courtesy of the Chicago Association of Commerce. Mr. Armstrong, of the Chicago Association of Commerce, will act as escort for the ladies. Wednesday morning at 10 o'clock the ladies will leave for an inspection of the plant of Sears, Roebuck & Co., probably the largest institution of its kind in the world. After inspecting the plant, Sears, Roebuck & Co. are going to give the ladies a complimentary luncheon. On Wednesday afternoon the Entertainment Committee suggests some of the larger department stores. Department stores always have a fascination for ladies. We also suggest the Art Institute, which is open that afternoon free. Tomorrow evening, while the men are having their banquet, we are going to give a theater party for the ladies of the convention at the Cort Theater, a complimentary theater party. Thursday morning, leaving at 10 o'clock, the ladies will be taken through the plant of the Chicago Telephone Co., a very interesting and profitable trip, and from there through the terminal station of the Chicago and Northwestern Railway Co. Probably a great many of us who use the Northwestern Station have never been in their emigrant rooms and watched those emigrant women with their children, how they can bathe them, wash their clothes and dry them, and all the facilities they have for handling that kind of passenger traffic. Returning Thursday noon, we will give a luncheon for the ladies at the ice rink in the College Inn. This will conclude the entertainment for the ladies. As far as the entertainment for the men at the convention is concerned there is so much important business that must be transacted that we have not arranged any entertainment that will interfere with it. Wednesday evening, tomorrow night, we are going to have the annual banquet. Professor Newell, of the University of Illinois, will be our guest of honor, and he has an address that is a corker. We are going to have something real to eat. We are going to have steaks, individual steaks, not the kind we used to get about a half an inch thick, but real big thick steaks 3 ins. thick. We are going to have some baked potatoes, we are going to have some fine oysters, and we have a musical program arranged that is going to start in when we sit down, and it is going to keep us sitting up on the edges of our chairs all the time.

It is customary the first evening for the men of the Convention informally to go to some treats. There are possibly four or five shows that can be picked out, and for the convenience of the members who are from out of town we have made reservations at the Illinois theater for 40 seats. We have got them in the first, second and third rows in the balcony, the best seats in the house. The show, I might say, is "The Follies." That will possibly be of interest to some of the members of the Association. Those members who desire to see that performance

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this evening, if they will see me at the Secretary's office, and have $2 in hand, which is the price of the tickets, I will endeavor to see that everyone is supplied. I thank you (applause).

THE PRESIDENT: Now, our order of business this afternoon will be changed a little. Mr. Kuehn is not here. The first order of business will be the reading of Mr. Goss' paper, and then Mr. Cherrington's paper. Then we will take the papers that are to come up tomorrow morning at 10 o'clock, skipping the Committee report. We will do that so as to expedite the business of the convention as much as we possibly can. Now, gentlemen, if there is nothing further, we stand adjourned till 2 o'clock. Adjourned.

An adjournment was then taken till 2 o'clock P. M.

PROGRAM.

TUESDAY FORENOON.

1. Opening by Prayer.....Dr. John Timothy Stone
2. Address of Welcome.....J. W. Kendrick
3. President's Address.....J. H. Waterman
4. Report of the Secretary-Treasurer.....F. J. Angier
5. Appointment of Special Committees.
6. Report of Entertainment Committee.....A. R. Joyce, Chairman

TUESDAY AFTERNOON.

Plant Operation and Miscellaneous.

7. Creosoted Piling and Poles.....Frank W. Cherrington
8. Methods of Creosoting Douglas Fir Timbers.....O. P. M. Goss
9. Notes on Measuring Devices and on Methods of Determining Cubical Contents Per Charge.....C. W. Lane
10. Selecting and Buying Fuel.....W. H. Grady
11. The Foreign Creosote Oil Situation.....G. A. Lembcke
12. Woods Suitable for Cross Ties.....R. Van Metre
13. Quantity of Zinc Chloride Per Tie or Per Cubic Foot of Timber, and Method of Determining the True Strength of the Solution.....W. F. Goltra
14. Report of Committee on Advertising.....F. J. Angier, Chairman
15. Report of Committee on Statistics.....E. T. Howson, Chairman

WEDNESDAY FORENOON.

Preservatives and Specifications.

16. Marine Borers—From the Wood-Preservers' Standpoint—(Illustrated by Stereoptican Views).....Dr. L. F. Shackell
17. Report of Special Committee on Specifications for Preservative for Wood Paving Blocks.....S. R. Church, Chairman
18. Discussion on Preservatives for Wood Blocks.....C. N. Forrest
19. Discussion on Preservative Specifications for Wood Paving Blocks, A. E. Larkin

WEDNESDAY AFTERNOON.

Preservatives and Specifications—Continued.

20. Report of Committee on Specifications for the Purchase and Preservation of Treatable Timber.....E. A. Sterling, Chairman

Ties and Wood Block Paving.

21. Fungi Which Grow on Untreated Ties or Untreated Wood. (With Stereopticon Views).....Dr. H. von Schrenk
22. Treated Wood Block for Factory Flooring and Miscellaneous Uses, C. H. Teesdale
23. Report of Committee on Wood Block Paving.....C. H. Teesdale, Chairman
24. Report of Committee on Service Tests of Wood Block Paving, A. E. Larkin, Chairman
25. Discussion on Woods Suitable for Cross Ties, C. P. Winslow and J. A. Newlin
26. Reclaiming Arid Lands.....F. H. Newell

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THURSDAY FORENOON.

Ties and Timber—*Continued.*

27. Report of Committee on Service Tests of Cross Ties, C. P. Winslow, Chairman.
28. Report of Committee on Service Tests of Bridge and Structural Timber, H. M. Rollins, Chairman

Business Session.

Report of Committee on Constitution.....John Foley
Report of Committee on Resolutions.....L. B. Moses, Chairman
Report of Memorial Committee.....S. D. Cooper, Chairman
Election of Officers.

TUESDAY AFTERNOON SESSION.

January 18.

The meeting was called to order by President Waterman at 2 o'clock P. M.

THE PRESIDENT: The first thing on the program this afternoon will be a paper by Mr. Frank W. Cherrington on "Creosoted Piling and Poles."

CREOSOTED PILING AND POLES

By Frank W. Cherrington.

Government statistics showing the annual consumption of piling and poles are startling. It is only when one recalls the innumerable lines of telephone and telegraph poles paralleling the railroads, traction lines and highways of this country, that he may sense the extraordinary yearly demand there must be for new construction and renewals due to breakage and decay. A close second to pole consumption is the use of piling for bridge, trestle, wharf and harbor construction along rivers, lakes and seaports by Government and municipality, by railroads, traction lines and private corporations.

Like all great progressive movements, the creosoting of such materials as an economic proposition has been slow of adoption. But in 1914, statistics show that nearly 1,500,000 cu. ft. of poles, averaging 30 ft. in length, and 8,062,000 cu. ft. of piling, averaging 40 ft. in length, were given a preservative treatment in their entirety, by an efficient creosoting process.

Many piles are creosoted annually for use in warm sea water as a protection against marine borers. Poles are also creosoted in great numbers in very warm or moist climates as a protection against decay. But until recently little has been done along this line in the more northern climates, where immense quantities of untreated piling and poles are annually destroyed because of decay.

Wood is the favorite material for poles and piling, providing a proper creosoting treatment adds durability to its many other advantages. The recent increase in the use of creosoted timbers for these

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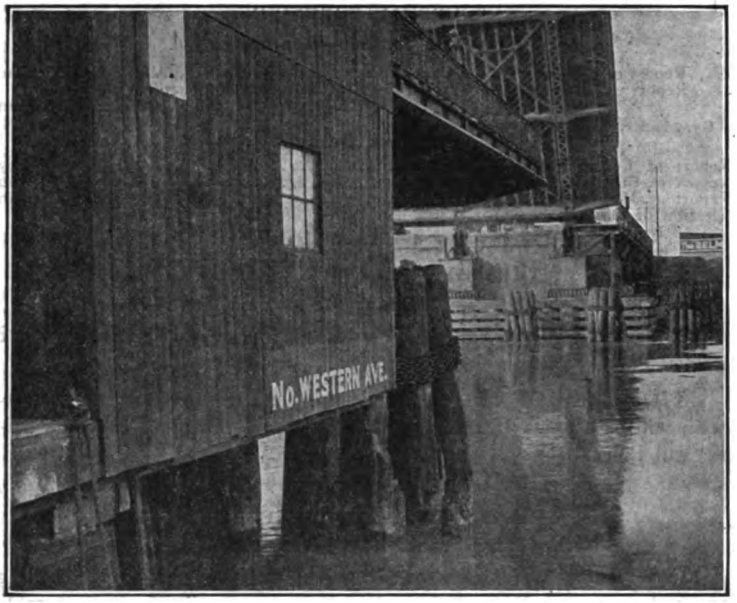
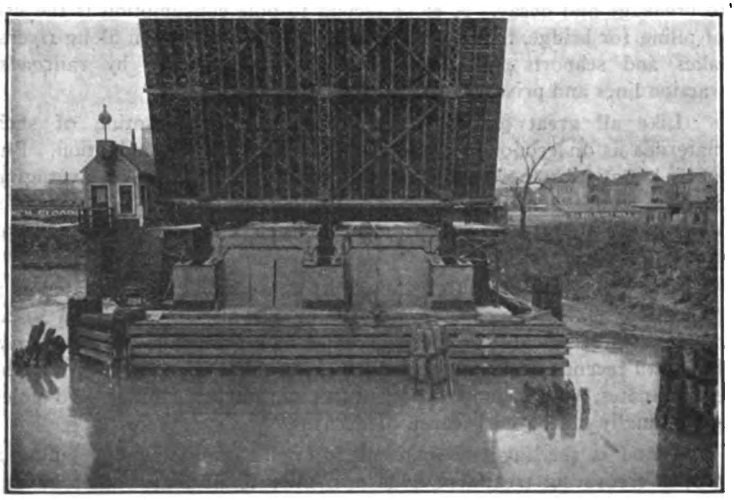


"A."—North Western Ave. Bridge, Chicago. (Looking North.)



"B."—Protection North End of North Western Ave. Bridge, Chicago.

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purposes has been largely due to the now generally recognized fact that the first cost of a long-lived creosoted pile or pole is far less, ultimately, than the cost of replacing untreated short-lived material.

There are many instances where creosoted piling and poles have many times outlasted the untreated, lower priced timbers, only a very few of which are herewith cited. In 1878 creosoted pine piling was placed in Lake Pontchartrain, La. These piles are still in good condition after 37 years' service, while untreated pine piling in that vicinity was destroyed by marine borers in from 1 to 2 years.

In 1882 the L. & N. R. R. erected a trestle near Escanaba Bay on the Gulf of Mexico. A portion of this material was washed away in the great storm of 1906, but some of the stringers were recovered and found to be in excellent condition.

In western Europe poles treated under pressure by the Rueping process last at least 21 years, while untreated poles last less than 8 years. In Prussia over a million poles were so treated from 1892 to 1911.

The writer is indebted to F. H. Avery, Engineer of Bridge Construction and Repairs of the City of Chicago, Ill., for the photographs and data presented herewith in regard to Chicago's experience with untreated oak piling. Mr. Avery made a thorough investigation of the condition of untreated oak piling in the Chicago River and Lake Michigan. This inspection led to a trip along the Mississppi River, where it was found that the life of creosoted piling far exceeded the life of any untreated piling placed under similar conditions.

Before going into the subject further, it may be of interest to note here that the decay of a pile (except in warm sea water where it is attacked by marine borers below the water line) will, without exception, originate at the wind and water line. With the exception of a short distance above and below this line, the balance of the timber will remain solid and sound for many years. But that portion subjected to alternate wet and dry conditions, will rapidly deteriorate in strength and usefulness. Similarly, telephone or telegraph poles decay rapidly only at the ground line, except in very warm or moist climates, because that portion of it in close contact with the soil will continually absorb moisture. The photographs here exhibited demonstrate very forcibly the activity of decay of piling at the wind and water line, in waters free from sea borers.

Photograph "A" shows the destructive decay of untreated oak piling at the North Western Avenue Bridge, after 11 years' service in the Chicago River. This was taken in 1915. The bridge was completed in 1904. Note particularly the center clump of piling on the far side.

Photograph "B" shows what happened after this center clump had

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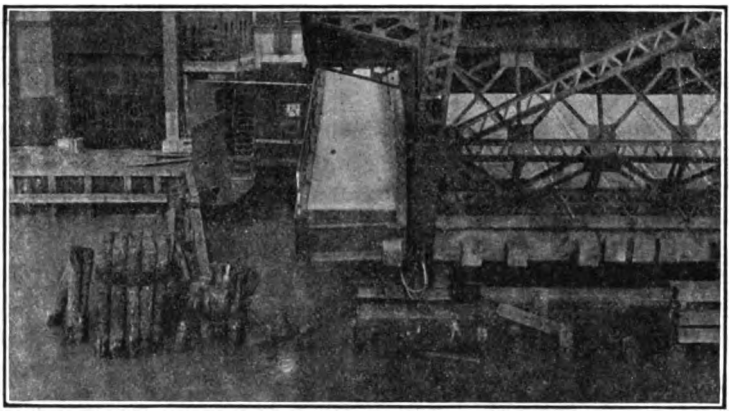
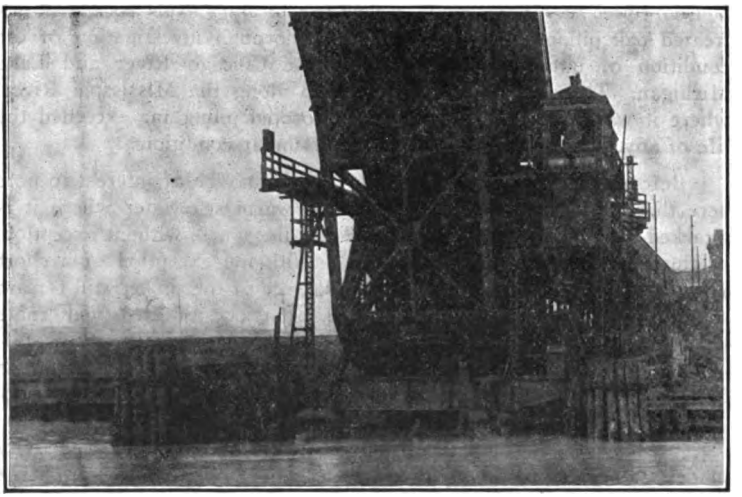
been slightly touched by a tug. The destructive decay at the wind and water line transformed the protective clump into a mere shell, so that



"C."—South Ashland Ave. Bridge, Chicago. (Looking North.)



"D."—Taylor Street Bridge, Chicago. (Looking West.)

under a slight impact it toppled over and floated away—almost as easily as breaking a cigar in your fingers. That this clump was in no worse condition than the others, is shown by the clump on the extreme left which fell apart in the same way.

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Photograph "C" shows the damage and loss due to decay at the wind and water line, of the protection for the South Ashland Avenue Bridge. The new clump shown on the left has been creosoted.

Photograph "D" shows the almost complete loss of protection at the Taylor Street Bridge. The new clumps of piling on each side have been creosoted.

Photograph "E" shows all that is left of the piling protection at the North Halstead Street Bridge. "F," "G" and "H" also show the ravages of decay at the wind and water line after a few years in the Chicago River.

Photograph "I" shows a comprehensive view of the interior protection of the Wells Street Bridge, composed of creosoted piling clumps with protecting aprons. These aprons are never creosoted, but are heavily coated with a cheap grease. A single protection such as this costs over $20,000, of which $15,000 is in the piling, and $5,000 in the apron.

The useful life of untreated oak piling in the Chicago River has been found to be about 8 years. At the end of that time the wood becomes so soft that the spikes are very easily withdrawn upon any slight stress or strain, thus allowing the chains to drop off.

Experience with piling in other localities warrants the assumption that creosoted piling will give a life of at least 24 years. Therefore, we have the following:

Untreated Oak Piling, Life 8 years		Creosoted Oak Piling, Life 24 years	
" " " Cost	$10,000	" " " Cost	$15,000
Greased Aprons....."	5,000	Greased Aprons....."	5,000
Total	$15,000	Total	$20,000

Accordingly it would necessitate three sets of untreated oak piling, and (since clump piling may only be driven by removing the aprons) three sets of aprons, or an expenditure of $45,000 to last as long as one creosoted set costing $20,000. This means a saving of $25,000 every 24 years, or over $1,000 per year.

An economy far in excess of this could be expected, however, as in order to work a pile driver in the draw of the bridge span, it is necessary to place the bridge "out of service." This can be done only from 1:00 A. M. to 5:00 A. M., and even then a roar of protest arises from the public.

Thus it is easily seen that, any way one may look at it, the use of creosoted piling means a saving in both time and money to any city using such construction for bridge protection, dock or wharf work.

The first creosoted piling used by the city of Chicago was given a

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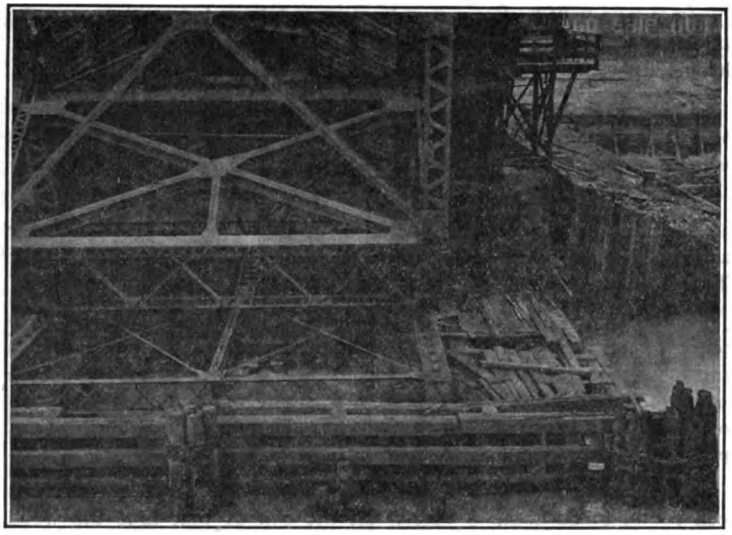
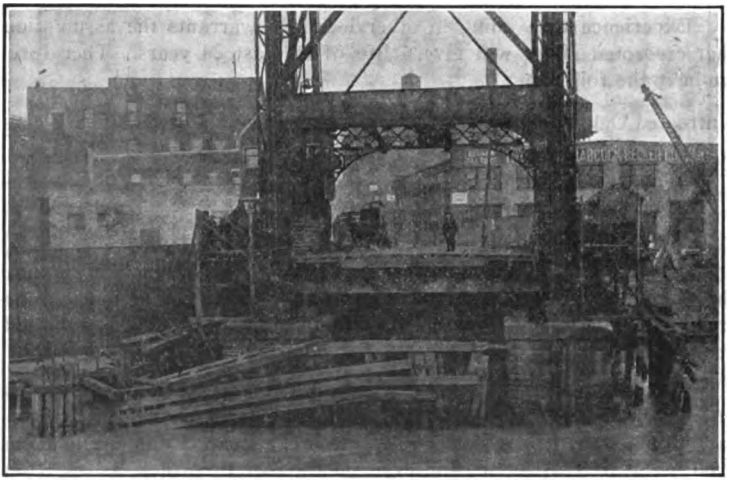


"E."—New Halsted Street Bridge, Chicago. (Looking North.)



"F."—South Halsted Street Bridge, Chicago. (Looking North.)

treatment of 8 lbs. of creosote oil per cu, ft. of timber by the Rueping process. Later this specification was changed to a "two-stage" treatment, consisting of an initial injection of 8 lbs. of creosote per cu. ft. of timber by the Rueping process, followed by a final injection of 4 lbs.

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of creosote per cu. ft. of timber by the Full Cell process. The function of the "two-stage" treatment is to obtain a maximum penetration by the "first-stage" Rueping process and a maximum waterproofing and sealing of the exterior wood cells by the "second-stage" of the treatment.

Many engineers would more generally specify creosoted piling and poles for structural purposes, if it were possible to efficiently creosote under pressure, at low cost, only those portions of such materials as are exposed to rapid decay. The city of Chicago, for instance, although now using creosoted piling of necessity, pays for creosoting the entire length of the pile, when about 75% will not be exposed to decay. About 30 ft. of a 45-ft. pile is constantly submerged beneath the river and would never decay, while about 12 ft. only protudes and is subject to deterioration, unless creosoted. Piling and sheating below the water are always in perfect condition, unless the water is infested by marine borers.

Beyond question the most efficacious method of treating any timber is by using some process employing a hydraulic pressure to insure a thorough penetration of the preservative throughout the wood volume. Penetration is essential to the permanence and effectiveness of the treatment, and without pressure, maximum penetration may not be secured. The prevention of decay by the application of preservative oil is permanent or temporary, depending upon the efficiency with which penetration is obtained.

Any superficial coating of preservative oil upon the surface of the exposed portion of the timber, such as painting with a creosote or carbolineum, or dipping a portion of the timber in the preservative, are at best but temporary expedients.

Therefore, any process which may do away with make shift treatments, and place the butt treatment of poles and piling upon a scientific, economical and efficient basis, deserves careful consideration.

From the above data, it is seen that a thorough creosoted butt treatment, of the woods now generally used and treated in their entirety, to protect the piles or poles at the wind and water, or the air and ground lines, respectively, should give very satisfactory results. Especially in more northern climates where that portion of the timber above the ground line, of poles, and below the water line, of piling, seldom, if ever, decay.

Until recently, engineers have considered it impractical as well as impossible to treat, by the injection of creosote oil under pressure, the butt only of piling or telephone poles. The writer understands that there is now in process of development, at least one practical means of accomplishing this long sought end, by providing a vertical cylinder for

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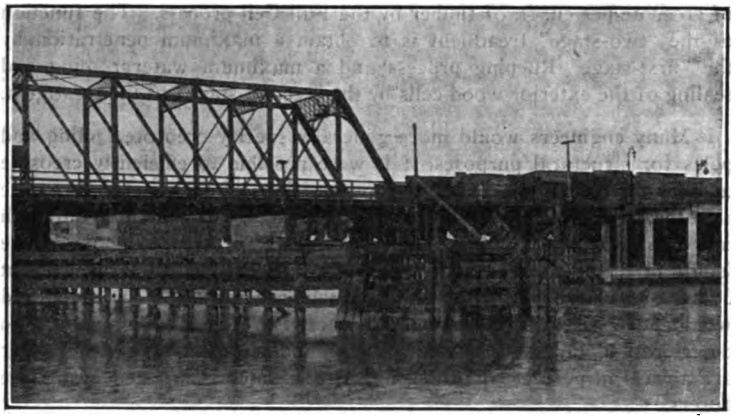

"G."—Diversey Street Bridge, Chicago. (Looking North-East.)

"H."—West Division Street Bridge, Chicago. (Looking North.)

injecting by any standard process, any required amount of preservative into the butts only of piling or poles, while the upper portions of the timbers are merely surrounded by the compressing medium, air.

Such a butt treatment of piling or poles with pressure by means of a vertical cylinder would accomplish the following results:

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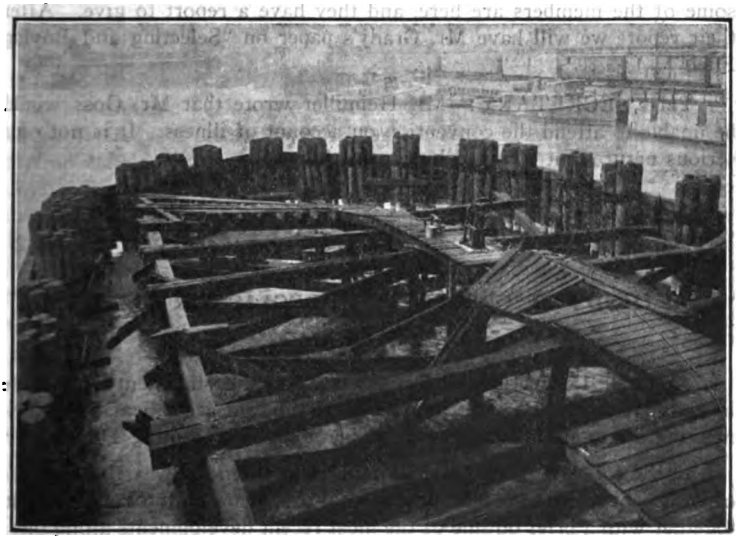
1. It would place the butt treatment upon a strictly reliable and scientific basis.
2. It would permit more than a mere treatment of the sap wood.
3. It would place under control the amount of creosote injected per cubic foot of timber.
4. It would allow any desired process of preservative treatment to be utilized at the butt only, of a pole or pile.
5. It would reduce cost of pressure treatment without reducing efficiency of preservation, as the same penetration of preservative is secured at the vulnerable air and water line, or air and ground line portion, as if the entire timber is treated under pressure.

Creosoted piling and poles treated in their entirety are an economical investment. And a lower priced, equally efficient means of



"I."—Wells Street Bridge, Chicago. (Interior Protection.)

treating only these parts of such timbers so susceptible to rapid decay, should, upon perfection, accelerate the adoption of creosoted piling and poles on a much larger scale.

MR. FRANK W. CHERRINGTON: I might add, Mr. President, that Mr. Avery and City Engineer Ericsson have very kindly offered a tug to any members of the Wood-Preservers' Association who are interested in the subject of piling, in order that a trip may be made along the Chicago River to inspect the condition of the untreated and creosoted piling at the various bridge protecting sites. Owing to the meetings of the Association, of course this trip could not possibly be taken

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until Friday morning, but if any members of the Association want to take this trip (the tug will accommodate about 40), give your names to Mr. Joyce, Chairman of the Entertainment Committee, and we will be glad to make the necessary arrangements (applause).

THE PRESIDENT: Gentlemen, the paper is before you. Is there anyone who wants to discuss it? Has anyone anything to say upon it? Mr. Cherrington, you seem to have covered the ground so thoroughly nobody has anything to say about it.

Mr. Angier will read Mr. O. P. M. Goss' paper on "Methods of Creosoting Douglas Fir Timbers." Mr. Goss is sick; he expected to be here. After the reading of the paper we will have the report of Committee No. 4 (Plant Operation). The Chairman is not here, but some of the members are here, and they have a report to give. After their report we will have Mr. Grady's paper on "Selecting and Buying Fuel."

THE SECRETARY: Mr. Heimiller wrote that Mr. Goss would be unable to attend the convention on account of illness. It is not of a serious nature, but confined him to his home.

METHODS OF CREOSOTING DOUGLAS FIR TIMBERS.

By O. P. M. Goss.

At the 1915 meeting of this Association the statement was made by me that on the Pacific Coast we were doing a great deal of experimenting, in an effort to improve the methods of creosoting Douglas fir.

In the following paper I shall indicate in a general way the methods of treatment which have been practiced in past years on the Pacific Coast, together with a brief outline of the most recent developments along these lines.

While in charge of the Seattle Timber Testing Laboratory of the Forest Service, the writer had unusual opportunity to study the effect of commercial treatments upon the strength of Douglas fir bridge stringers. The results of these investigations have recently been published by the Forest Service in Bulletin No. 286, and show that bridge stringers treated by the boiling and steaming processes lost from 33 to 35% of their original strength. Due to this loss in strength, it was necessary to use low fiber stresses in the design of structures built of creosoted timber. In an effort to eliminate this difficulty a large number of experiments have been made with various treatments, and that which has been found to date to give the best results is discussed in this paper.

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There are two general classes of structural timber, as follows:

1. That which must retain its full strength after treatment.

2. That in which the strength is not so important, the real problem being that of protection.

No difficulty has been experienced in the past in handling the second class of material. The trouble has been entirely with the first class. It has been possible to secure a good oil penetration by both the steaming and boiling processes.

From experiments which have been made it has been shown that high temperatures and high pressures in these treatments are largely responsible for the loss in strength of the wood. The treatments used in the past have been applied, about as follows:

Boiling Process.

The timbers were placed in the retort in a green condition, and boiled in creosote oil under atmospheric pressure for 22 to 24 hours at a temperature ranging from 230° to 260° F. This boiling period was used to season the timber and prepare it for receiving the oil. After the boiling period pressure was applied, rising from zero to as high as 145 to 185 lbs. per sq. in. The pressure was continued over a period of 4 to 6 hours, at a temperature of approximately 180° to 230° F. By this method, 10 to 14 lbs. of oil per cubic foot were injected into the wood.

Steaming Process.

The timbers were placed in the retort in a thoroughly green condition and steamed at 90 lbs. pressure per square inch, for 4 to 7 hours, at a temperature of approximately 325° to 335° F. A vacuum of approximately 20 in. was then applied for 18 to 20 hours while the temperature ranged above 220° F. At the end of the vacuum period creosote oil was introduced and pressure applied, rising from zero up to 160 lbs. per square inch. This pressure period continued for 2 to 4 hours, at a temperature of approximately 208° F. Ten to 14 lbs. of oil per cubic foot of wood were usually injected into the timber by this process.

It will be noted that in both the above processes high temperatures were applied. The temperature used in the boiling process was lower than that used in the steaming, but was applied over a much greater period of time.

In recent experiments both temperatures and pressures have been reduced and the vacuum made to take a more important part in the process. The most successful treatment yet devised for treating bridge stringers and similar forms without loss in strength is that of "boiling

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under a vacuum." When green timbers are creosoted by this method the treatment requires approximately 26 hours, and is, in general, as follows:

Boiling Under A Vacuum Process.

The timbers are placed in the retort and creosote oil introduced at a temperature of 160° to 180° F. Heat is applied, and the temperature of the oil gradually raised to 190° F. and held at that temperature for 5 to 6 hours, a sufficient length of time to warm the timbers through.

When the timbers are thoroughly warmed, a vacuum of 24 to 27 in. is drawn on the oil, still holding a temperature of 190° F. This vacuum is drawn through an overhead pipe extending from the top of the retort for 36 ft. vertically into the air and returning to the condenser. The purpose of this pipe is to prevent the creosote oil from boiling over into the condenser while boiling under the vacuum. This vacuum is started at 16 to 18 in., and as the timber seasons, is gradually raised to 24 to 27 in. The full period of vacuum is 12 to 16 hours. It is continued until the rate of seasoning of the timber is 0.1 lb. of water per cubic foot of wood per hour. After this finished rate of seasoning is reached the vacuum is broken and pressure on the oil started, which rises as high as 120 to 135 lbs. per square inch, and continues over a period of 4 to 6 hours. The temperature of the oil during the pressure period drops from 190° to 180° F. By this process 10 to 14 lbs. of oil per cubic foot may be pressed into the wood.

This method of treatment is a modification of the Boulton process, and at the low temperatures used seasons the wood even better than the old boiling process which employed so much higher temperatures. Timbers treated by the method of "boiling under a vacuum" are noticeably easier to press than timbers treated under the old boiling process. The edges of the checks which develop, due to seasoning, are very sharp, showing that the wood is not burned at all.

Bridge Stringers.

In order to carry the test still farther, and to determine the effect of this treatment upon the strength of Douglas fir bridge stringers, two shipments of full sized stringers were selected, and treated in four different charges at the plant of the St. Helens Creosoting Co., St. Helens, Oregon. These stringers were of three sizes, 7"x14"x28', 7"x16"x30', and 10"x14"x28'. They were carefully selected so that the two halves were of equal quality, cut in the center, and one-half creosoted and tested, and the other half tested in its natural green condition. The 7"x14" and the 10"x14" stringers were tested on a 13-ft. span, and the 7"x16" stringers were tested on a 14-ft. span.

All stringers were tested under one-third point loading. The

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TABLE 1.

EFFECT OF CREOSOTING BY "BOILING UNDER A VACUUM" ON THE STRENGTH AND STIFFNESS OF DOUGLAS FIR. BRIDGE STRINGERS TREATED GREEN. TIMBERS 7"x14"x14'. TESTED UNDER ⅓ POINT LOADING ON A 13' SPAN.

Beam No.	Rings per Inch		Fiber Stress at Elastic Limit Lbs. per Sq. In.			Modulus of Rupture Lbs. per Sq. In.			Modulus of Elasticity 1000 lbs. per Sq. In.			Maximum Horizontal Shear Developed Lbs. per Sq. In.			Manner of Failure.	
	N	T	N	T	T in % of N	N	T	T in % of N	N	T	T in % of N	N	T	T in % of N	N	T
1	13	13	4620	4140	89.6	7330	5780	78.9	1970	1730	87.8	503	393	78.3	Tension and Hor. Shear	Tension and Hor. Shear
6	..	..	4190	4550	108.5	6083	6291	103.3	1700	1587	93.4	415	426	102.5	Tension	Tension and Hor. Shear
7	11	11	4140	4490	108.3	6070	6730	110.9	1857	1845	99.4	415	458	110.0	Horizontal Shear	Hor. Shear and Tension
9	12	13	3930	4040	103.0	5500	5390	98.0	1779	1760	98.9	377	366	97.0	Tension and Hor. Shear	Tension and Hor. Shear
10	7	7	3720	3900	104.8	5422	5620	103.7	1696	1545	91.1	371	383	103.2	Tension	Tension and Hor. Shear
11	10	10	3680	3375	91.7	5328	4980	93.3	1295	1513	116.8	363	339	93.4	Tension	Horizontal Shear
14	10	9	3685	4105	111.3	4605	5440	118.2	1885	1760	93.4	314	369	117.5	Tension	Tension
15	12	14	3070	2885	94.0	4410	4750	107.7	1187	1266	106.7	298	319	107.0	Tension	Tension
16	11	11	3920	3190	81.4	4408	4725	107.2	1450	1420	97.9	302	324	110.8	Tension	Tension
Avg	10.8	11.0	3884	3853	99.2	5460	5523	101.2	1647	1603	97.3	373	375	100.5		

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TABLE 2.

EFFECT OF CREOSOTING BY "BOILING UNDER A VACUUM" ON THE STRENGTH AND STIFFNESS OF DOUGLAS FIR. BRIDGE STRINGERS TREATED GREEN. TIMBERS 7"x16"x15'. TESTED UNDER ⅓ POINT LOADING ON A 14' SPAN.

Beam No.	Rings per Inch		Fiber Stress at Elastic Limit Lbs. per Sq. In.			Modulus of Rupture Lbs. per Sq. In.			Modulus of Elasticity 1000 lbs. per Sq. In.			Maximum Horizontal Shear Developed Lbs. per Sq. In.			Manner of Failure	
	N	T	N	T	T in % of N	N	T	T in % of N	N	T	T in % of N	N	T	T in % of N	N	T
4	16	16	4225	4385	103.8	6190	6145	99.3	2032	1915	94.2	460	463	100.7	Horizontal Shear	Horizontal Shear
13	13	13	3858	3815	98.9	5275	5530	104.7	1815	1726	95.1	381	397	104.2	Horizontal Shear	Horizontal Shear
Avg.	14.5	14.5	4042	4100	101.4	5733	5838	101.8	1924	1821	94.6	421	430	102.2		

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TABLE 3.

EFFECT OF CREOSOTING BY "BOILING UNDER A VACUUM" ON THE STRENGTH AND STIFFNESS OF DOUGLAS FIR BRIDGE STRINGERS TREATED GREEN. TIMBERS 10"x14"x14'. TESTED UNDER ⅓ POINT LOADING ON A 13' SPAN.

Beam No.	Rings per Inch		Fiber Stress at Elastic Limit Lbs. per Sq. In.			Modulus of Rupture Lbs. per Sq. In.			Modulus of Elasticity 1000 lbs. per Sq. In.			Maximum Horizontal Shear Developed Lbs. per Sq. In.			Manner of Failure	
	N	T	N	T	T in % of N	N	T	T in % of N	N	T	T in % of N	N	T	T in % of N	N	T
2	13	13	5740	3580	62.4	6700	5550	82.8	2019	1863	92.3	456	375	82.2	Horizontal Shear	Tension
3	15	15	4420	3480	78.7	6210	4900	78.9	1739	1538	88.4	423	330	78.0	Horizontal Shear	Horizontal Shear
5	12	12	5190	5420	104.5	6130	6780	110.6	1702	1757	103.2	418	459	109.8	Horizontal Shear	Tension and Hor. Shear
8	8	8	5580	5430	97.3	5880	6280	106.8	1824	1750	95.9	403	425	105.5	Horizontal Shear	Tension
12	12	12	3420	3050	89.2	5280	5160	97.7	1463	1395	95.4	359	350	97.5	Tension	Horizontal Shear
Avg.	12.0	12.0	4870	4192	86.1	6040	5734	95.0	1749	1661	94.9	412	388	94.2		

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TABLE 4.

EFFECT OF CREOSOTING BY "BOILING UNDER A VACUUM" ON THE STRENGTH AND STIFFNESS OF DOUGLAS FIRS. BRIDGE STRINGERS TREATED GREEN. TIMBERS 7"x14"x14', 7"x16"x15", and 10"x14"x14'. TESTED UNDER ⅓ POINT LOADING ON A 13' TO 14' SPAN.

Beam No.	Rings per Inch		Fiber Stress at Elastic Limit Lbs. per Sq. In.			Modulus of Rupture Lbs. per Sq. In.			Modulus of Elasticity 1000 lbs. per Sq. In.			Maximum Horizontal Shear Developed Lbs. per Sq. In.			Manner of Failure	
	N	T	N	T	T in % of N	N	T	T in % of N	N	T	T in % of N	N	T	T in % of N	N	T
1	13	13	4620	4140	89.6	7330	5780	78.9	1970	1730	87.8	503	393	78.3	Tension and Hor. Shear	Tension and Hor. Shear
2	13	13	5740	3580	62.4	6700	5550	82.8	2019	1863	92.3	456	375	82.2	Horizontal Shear	Tension
3	15	15	4420	3480	78.7	6210	4900	78.9	1739	1538	88.4	423	330	78.0	Horizontal Shear	Horizontal Shear
4	16	16	4225	4385	103.8	6190	6145	99.3	2032	1915	94.2	460	463	100.7	Horizontal Shear	Horizontal Shear
5	12	12	5190	5420	104.5	6130	6780	110.6	1702	1757	103.2	418	459	109.8	Horizontal Shear	Tension and Hor. Shear
6	..	..	4190	4550	108.5	6083	6291	103.3	1700	1587	93.4	415	426	102.5	Tension	Tension and Hor. Shear
7	11	11	4140	4490	108.3	6070	6730	110.9	1857	1845	99.4	415	458	110.0	Horizontal Shear	Hor. Shear and Tension
8	8	8	5580	5430	97.3	5880	6280	106.8	1824	1750	95.9	403	425	105.5	Horizontal Shear	Tension
9	12	13	3930	4040	103.0	5500	5390	98.0	1779	1760	98.9	377	366	97.0	Tension and Hor. Shear	Tension and Hor. Shear
10	7	7	3720	3900	104.8	5422	5620	103.7	1696	1545	91.1	371	383	103.2	Tension	Tension and Hor. Shear
11	10	10	3680	3375	91.7	5328	4980	93.3	1295	1513	116.8	363	339	93.4	Tension	Horizontal Shear
12	12	12	3420	3050	89.2	5280	5160	97.7	1463	1395	95.4	359	350	97.5	Tension	Horizontal Shear
13	13	13	3858	3815	98.9	5275	5530	104.7	1815	1726	95.1	381	397	104.2	Horizontal Shear	Horizontal Shear
14	10	9	3685	4105	111.3	4605	5440	118.2	1885	1760	93.4	314	369	117.5	Tension	Tension
15	12	14	3070	2885	94.0	4410	4750	107.7	1187	1266	106.7	298	319	107.0	Tension	Tension
16	11	11	3920	3190	81.4	4408	4725	107.2	1450	1420	97.9	302	324	110.8	Tension	Tension

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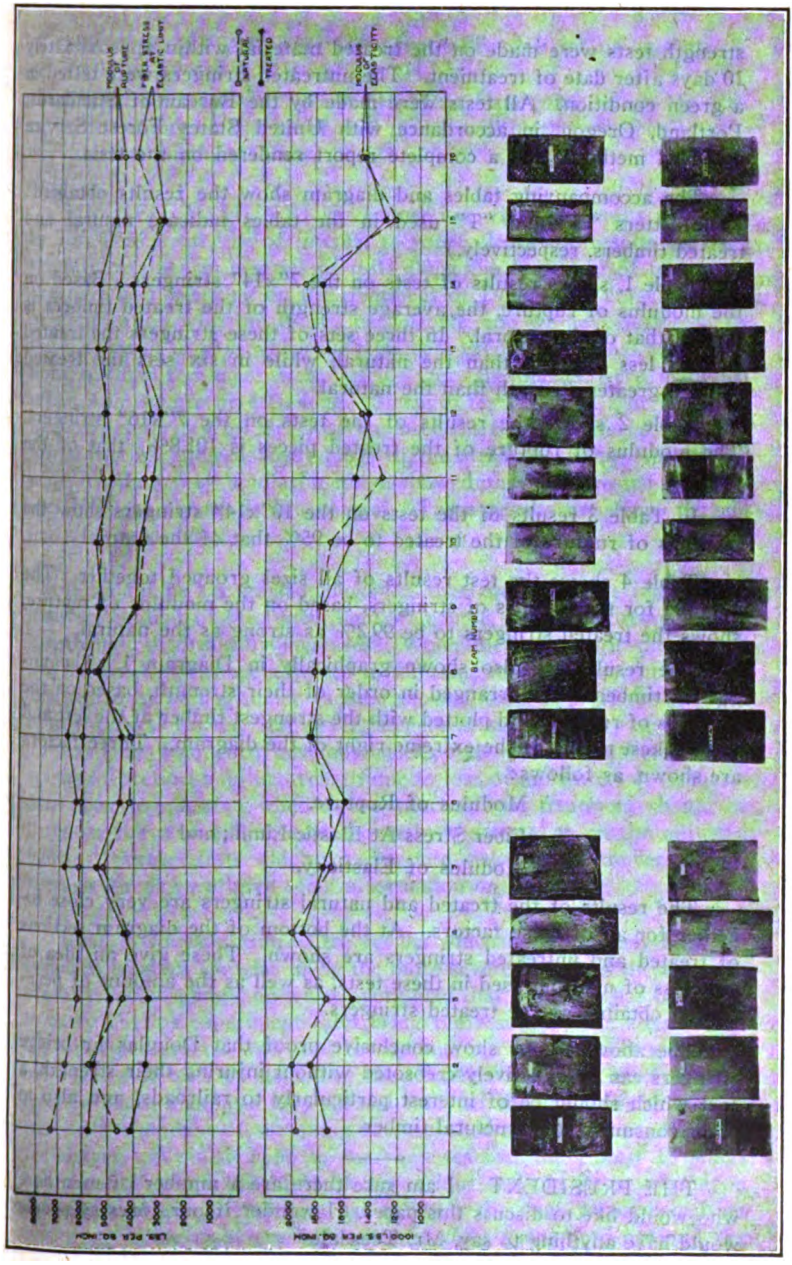

Diagram 1.—Results of Tests to Determine Strength of Treated and Untreated Timber.

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strength tests were made on the treated material within approximately 10 days after date of treatment. The untreated stringers were tested in a green condition. All tests were made by the Bureau of Standards, Portland, Oregon, in accordance with United States Forest Service standard methods, and a complete report rendered on the tests.

The accompanying tables and diagram show the results obtained: (The letters "N" and "T" used in the tables indicate natural and treated timbers, respectively.)

Table 1, shows results of tests on the 7"x14" stringers. Based on the modulus of rupture, the average strength of the treated timbers is 101.2% that of the natural. In three sets of these stringers the treated showed less strength than the natural, while in six sets the treated showed greater strength than the natural.

Table 2 shows the results of the tests on the 7"x16" stringers. The modulus of rupture of the treated pieces is 101.8% that of the natural.

In Table 3 results of the tests on the 10"x14" stringers show the modulus of rupture of the treated to be 95% that of the natural.

Table 4 shows the test results of all sizes grouped together. The average for the 16 pairs of stringers, based on the modulus of rupture, shows the treated stringers to be 99.2% as strong as the natural.

The results are also shown graphically in Diagram 1. The untreated timbers were arranged in order of their strength, based on the modulus of rupture, and plotted with the strongest timber at the left and the weakest timber at the extreme right of the diagram. Three factors are shown, as follows:

Modulus of Rupture.
Fiber Stress At Elastic Limit; and
Modulus of Elasticity.

The results of the treated and natural stringers are very close together for all of these factors. At the bottom of the diagram sections of treated and untreated stringers are shown. These give an idea of the class of material used in these tests, as well as the amount of penetration obtained in the treated stringers.

The above results show conclusive proof that Douglas fir bridge stringers can be effectively creosoted without injuring their strength, a fact which should be of interest particularly to railroads, and also to other consumers of structural timber.

THE PRESIDENT: I am sure there are a number of men here who would like to discuss this paper. I wonder if our forestry people would have anything to say, Mr. Teesdale?

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MR. C. H. TEESDALE: Mr. Hunt will speak for us on that.

THE PRESIDENT: After Mr. Hunt I am going to ask Mr. Rex to say something on this paper, and then it will be thrown open to anyone who has anything to say.

MR. GEO. M. HUNT: In connection with the results described by Mr. Goss it may be of interest to you to learn the results we have recently obtained in a series of tests along the same line of treatment. We have been working on the treatment of Douglas fir for some time in co-operation with the West Coast people, and we have just recently run a series of tests in which the treatment used by Mr. Goss and variations of that treatment were used. Our treatments were made on sticks, 4 in. square by 4 ft. long. Strength tests showed that when the treatment described by Mr. Goss was used the treated material in modulus of rupture showed about 108% of the strength of the natural timber. Another very similar method showed that the treated material was 105% as strong as the natural. These results are from timbers just after treatment.

It should be recognized, however, that the treatment reduces the moisture content of the timber, and, of course, as timber becomes drier its strength theoretically increases. When the results for the treated and untreated sticks are adjusted to the same moisture content the timber treated by boiling under vacuum showed about 86% of the strength of the natural timber. However, structural sized timber, in ordinary air seasoning frequently develops checks and other defects, which offset the theoretical gain in strength due to loss of moisture. It is, therefore open to question whether the effect of the treatment should be based on the actual figures as shown by the tests, or on the adjusted figures. Further tests which we expect to make on the timber after it becomes air dry will give some information on this point.

Now, in consideration of the results which have formerly been obtained in treating Douglas fir by the more severe processes these results are very encouraging, and we are very glad that Mr. Goss has been able to carry out his experiments and bring the results to the attention of the wood-preservers. We hope to continue our experiments and carry out a series of tests on structural sized timbers treated at a commercial treating plant, making a very careful study of the effect of the method both on the amount of seasoning accomplished and on the condition of the timber. We also hope to carry on tests at the Forest Products Laboratory to show the effect of the various steps in the process upon the results obtained; that is, it has not been thoroughly established yet just what is the right pressure and the right vacuum to use and the

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proper temperature; also the length of the vacuum period and the pressure period might be changed. All these need further study. It seems that a detailed study of the whole process in this way is going to give us very valuable results, and with the work that has already been reported on, and the work outlined for the future, the problem of treating of Douglas fir is well on its way to a better solution than in the past.

THE PRESIDENT: Mr. Rex.

MR. GEO. E. REX: I do not know that I have anything to add to what Mr. Goss has said, as the tests that have been carried on at our plant since October have not gone far enough for us to be in a position to give definite figures. At that time, as Mr. Goss has outlined, we tested among other things, 400 7x16x30 stringers. We took 100 of those stringers and sawed them in two. Half of them were untreated, and the other half were treated. These stringers have just arrived at our testing laboratory at Topeka. And in the course of the next few months we will be able to give you the results of that test. Before that time I would not like to say either way what the results will be. One thing in the treatment of heart timber, I do say that our penetration for strictly all heart timber is equal, if not better, than it is under the boiling process, where we all realize the strength lost was very great. That feature of the test certainly is encouraging. You all realize one hundred stringers is quite a large experiment. If those tests show similar results to those obtained by Mr. Goss, it will certainly go a long way to show that boiling under vacuum is going to be a success with Douglas fir.

MR. H. M. NEWTON: Mr. President, the experience we had at our Sandstone plant some years ago may be of interest. I thought it was generally known to this Association. Mr. Hageboeck, who was directing the Government work done there at that time, presented a paper on the treatment of Douglas fir timbers before this Association some two years ago. The Government treated at our Sandstone plant some 4,000,000 or 5,000,000 ft. of Douglas fir in large sizes for use in the construction of barges. The first two years they specified that the material should be air-seasoned for about six months, and then treated by the usual vacuum and pressure process to obtain an absorption of 10 lbs. per cubic foot on the large sizes, and of 12 lbs. per cubic foot on the smaller sizes. In checking up on the treatments later we found that the average time of treatment on thoroughly air-seasoned material by that process was some 26 hours and a fraction. The year after that the same specification governed, but due to the fact that deliveries were delayed, it was impossible to hold the material in the yard until it had become air-seasoned. For that reason

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they permitted us to treat four or five charges as an experiment to see if we could get the required absorption without air-seasoning. We immersed the material in oil, filling the cylinder almost to the top and applied the vacuum in the same way as here described. I think the temperature of the oil was about 200° or 205°F., together with as high a vacuum as we could obtain extending over 8 or 10 hours. The absorption compared very favorably; in fact, the Government representatives thought that they were getting a better penetration with the same amount of oil than they got before. They then permitted us to carry on the treatment of all the balance of the material just the same way, and we treated about 1,000,000 ft. just in that way. The average time of treatment was 19 hours, a reduction of about 7 hours. The penetration was decidedly better than we had obtained before where thoroughly air-seasoned material was used.

THE PRESIDENT: Dr. von Schrenk, would you like to say something on this paper?

DR. H. von SCHRENK: I read this paper with a good deal of interest. I think all of us who have had anything to do with the treatment of Douglas fir have been impressed with the fact that there is more to learn about the treatment of Douglas fir than almost any other class of timber we are using. It is very hard to pass on a series of tests of this character without actually having seen them. The impression I gather from the paper, however, is this: I consider it a very important contribution towards the investigation of treatments for Douglas fir. This is simply one step. I cannot help but think that this treatment is bound to a certain extent to reduce the various strength coefficients, and it will do so to do more than if the timber were dry. It seems to me that the next natural step in connection with this investigation is to have a great many more stringers treated and have them tested under full-sized conditions in order to obtain a little bit more extensive series of figures as to what can be depended upon in actual practice.

THE PRESIDENT: Does any other gentleman want to talk on this paper?

MR. F. D. MATTOS: Mr. President, I would like to ask Mr. Rex what temperatures his company recommends for the treatment of Douglas fir by the boiling process. I see that the temperatures quoted here are far in excess of what we would recommend to work with safety on this class of material.

MR. GEO. E. REX: Well, you possibly all realize that the treatment of Douglas fir is very different from the treatment of any other material inasmuch as the people who are doing this treatment are located, we might say, in a climate where they think air-seasoning is not

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justified. In other words, the damp atmosphere in which they are located affects the seasoning of the material. If you ask me personally, I think that Douglas fir can be air-seasoned the same as anything else.

THE PRESIDENT: Do you get good results from air-seasoning?

MR. GEO. E. REX: Now, again, that is just a matter of personal opinion. First, let me say sapwood of the Douglas fir if air-seasoned would be as good as the sapwood of longleaf pine and would treat just as readily. The heart penetration of air-seasoned Douglas fir is very erratic, more so than it is in the longleaf pine. We all realize that there is lots of longleaf pine that takes a very superficial penetration when it comes to air-seasoned stuff. The same thing applies, only more so, to Douglas fir. There will be a larger number of sticks that will have a smaller amount of penetration than there will be in the longleaf pine.

MR. F. D. MATTOS: I do not believe you understand my question, Mr. Rex. Your company, I believe, has considerable Douglas fir treated at plants on Puget Sound. What I wanted to know was whether you specified that the temperatures used shall not exceed 260°, or is it 225°, or 220° F., or what?

MR. GEO. E. REX: That is simply a matter of comparison. For instance, you take a cylinder that is thoroughly lagged and a thermometer located at a given point under a given condition and we would specify say 225° or 216°. For years the condition at a certain plant was such that we specified that they should not go over 216° for Douglas fir piling. That particular plant was not lagged, and the thermometer was placed in a certain location. When we put in another plant we thoroughly lagged its cylinders, placed the thermometer near the actual condition, and we found we could not get the sap out of the wood with the 216°. It was simply a matter of how nearly accurate our thermometer was recording the temperatures. We immediately found on experimenting with this new plant that the 216° we formerly specified would not do the work. We had to carry it 100 hours. Piling came out about the same way at 240° that it did at the other plant at 216°. Following this up with maximum thermometers placed in the inside of each cylinder we found that the maximum thermometers went no higher in the lagged cylinder that was registering 240° F. than in the unlagged cylinder that was showing 216° F.

So you have to know the condition and position of cylinders and thermometers before you can state temperature.

MR. F. D. MATTOS: At our West Oakland plant we use temperatures of 214° to 216° F. in treating sawed lumber and 220° to 226°F. on piling. That is the reason I asked Mr. Rex that question, because in this very important report Mr. Goss claims that the tem-

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peratures under the boiling process range from 230° to 260°F. I do not think that you can work those temperatures in safety. It is not what we commend.

THE PRESIDENT: Has anyone else anything to say on this subject?

MR. J. B. CARD: I would like to ask Mr. Rex if his company specifies steaming where Douglas fir has been seasoned before treatment.

MR. GEO. E. REX: As a matter of fact, there is no Douglas fir timber being seasoned upon the Pacific Coast as far as I know.

MR. F. D. MATTOS: If there is it is an accident.

MR. GEO. E. REX: As far as I know today there is no commercial treatment being carried on of Douglas fir seasoned timber.

THE PRESIDENT: I think this is very good information that we are getting. If anyone else has anything to say on this subject we would be glad to hear from him. Mr. Crawford, have you anything to say, or do you want to ask any questions about it, or is it too far removed from your territory?

MR. CARL G. CRAWFORD: Mr. President, I have had so little to do with the treatment of Douglas fir in the last four or five years I feel that I cannot add anything to the discussion of this subject which is now taking place.

THE PRESIDENT: Have our Kettle River people in Minneapolis or St. Paul, or wherever their plants are located, got anything to say? Well, if there is nothing further—now, do not complain that you have not had an opportunity to present your side of the case. If there is nothing further, we will pass to the next subject.

VACUUM PROCESS IN CREOSOTING.

By John D. Isaacs.

The experience of the Southern Pacific Co. indicates that the whole secret of successful artificial treatment of timber consists in bringing the sap to the boiling point at a slow and uniform rate, after which the operation may be pushed without injury to the timber.

Mr. Goss states that experiments have shown that high temperatures and high pressures in these treatments are largely responsible for the loss of strength in the wood. No doubt they are in some degree responsible, but the results are not consistent. Mr. Goss' experiments show that stringers treated by "Boiling Under Vacuum" gain in strength about 1.8%; by "Boiling at Atmospheric Pressure," temperatures 65° higher and pressure only 15 lbs. more than "Boiling

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Under Vacuum," loss of strength about 36%; and "Steaming Process," temperature 135° higher and pressure 15 lbs. more than "Boiling Under Vacuum," loss of strength 36%, or same as in "Boiling at Atmospheric Pressure."

If loss of strength were largely due to high temperatures and high pressures, and "Boiling at Atmospheric Pressure," causes such a great loss of strength against a gain for "Boiling Under Vacuum," why did not "Steaming Process" cause much greater loss of strength than "Boiling at Atmospheric Pressure?"

We note on page 4, Bulletin 286, United States Department of Agriculture, foot note 2, that "Sometime after the treatments (referring to 'Boiling at Atmospheric Pressure') were made it was reported by the treating plant officials that the thermometer giving this reading registered 40°F. too low," indicating that it was intended to raise temperature to 215° F. instead of 255° F., which would have been proper and should have given results closer to those of "Boiling Under Vacuum."

The creosoting plant as originally built by the Southern Pacific Co. at Oakland, Cal. was intended for use with the steam-vacuum process, and was so used with fair success on redwood and pine timber up to 1892, at which time attempts were made to creosote Douglas fir piles for building a wharf at Santa Monica. It was found impracticable to do so with this process. The trouble appeared to be the impossibility of keeping a temperature to correspond with a given vacuum and vice versa, so that the evolution of steam from the timber was spasmodic, and a curve plotted, showing the rate of evaporation for a given time during the process of drying, was very irregular, indicating a series of quasi-explosions in the timber, rendering it practically useless for the purposes intended.

It was due to this condition that the boiling process similar to above method, "Boiling at Atmospheric Pressure," was developed and adopted by the Southern Pacific Co. and subsequently made standard for creosoting timber by all its plants on the Pacific Coast.

When the boiling process was first introduced by the Southern Pacific Co. an obvious proceeding was to apply a vacuum during boiling, pumps for which were already installed and connected for previous use, so as to keep down the boiling point and thereby avoid any injury that might occur to the timber from high temperatures, (although the difference practically attained was only about 30° F., which seems to be borne out by Mr. Goss' experiments). This is the original Boulton process, which was invented about the year 1885, and operations were conducted in this manner for a time after its introduction at the Oakland works of the above company. No trouble was experienced in carrying over creosote by the vacuum pumps, as the

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slight quantity carried over was recovered in the condenser well and returned to the measuring tank.

It was found, however, that the use of the vacuum was uneconomical because the gain in energy due to vaporization at a reduced pressure is thoretically less than the expenditure of energy by the vacuum pumps; besides an additional loss occurred due to the inefficiency of the pumps themselves. Furthermore, for the reasons given above in the steam vacuum process, it was practically impossible to get an evaporation at anything like a smooth and regular rate.

Therefore, we abandoned some 24 years ago the use of a vacuum in the boiling process, and disconnected the vacuum pumps from our retorts, after which our results were more satisfactory as regards injury to the timber by checking.

After carefully considering the figures given in Mr. Goss' experiments the writer cannot believe that they are fair to the "Boiling Process at Atmospheric Pressure." If this method were carried through with as much care as "Boiling Under Vacuum" we should expect the results to be practically the same.

It is true that we still use the steam and vacuum process for Burnettizing fir ties. These, however, are relatively small and short pieces, readily dried by any process using heat. Also, the preservative is in aqueous solution, and, therefore, the timber does not need to be so dry as for creosoting.

It may be proper in this connection to call attention to the fact that the introduction of the boiling process brought about a large economy in fuel, time and labor.

Laboratory tests of the relative strength of untreated and treated stringers, unseasoned or seasoned five months after treatment, are, after all, no measure of the relative strength of the same stringers after several years of service, because of the more rapid deterioration in strength of untreated timber.

THE PRESIDENT: We have heard from Mr. Kuehn. He has been sick nearly all summer, and he is unable to be here. Two members of the Committee are here, Mr. Lane and Mr. Meyer. They have a report to make, and after their report we will have Mr. Grady's paper, and then we will discuss the whole proposition together.

MR. C. W. LANE: Owing to the illness of our Chairman, the Committee on Plant Operation has done practically nothing. Late in the year Mr. Kuehn wrote to me and asked me to do a little work on certain subjects. I assembled a few notes, and they were gotten to-

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gether too late for publication in the form of a pamphlet. I have been asked to read the paper, and asked how I would like to have it submitted, whether in the form of a minority report or independent paper, or how. I do not think it is worth the dignity of a minority report, and would be glad to leave its final disposition to the Executive Committee.

NOTES ON MEASURING DEVICES AND ON METHODS OF DETERMINING CUBICAL CONTENTS PER CHARGE.

By C. W. Lane.

Owing to the much regretted protracted illness of our chairman, the work of the Committee on Plant Operation for 1915 has been somewhat disorganized. This paper, hastily assembled at the eleventh hour, is offered for the sole reason that it is hoped that some discussion will ensue which will serve to define the opinions of our most experienced plant operators in the matters discussed.

Taking an inventory of preservatives means simply taking an accurate measurement thereof. We cannot measure anything accurately unless our working tools are accurate, and at the same time simple in construction and easily handled by the average operator.

Float-Gauge.

There are several methods in use at present for determining the amount of preservatives in tanks. Perhaps the one most commonly used is that of the float-gauge indicator. Almost universally the float, whether of wood or metal, is attached to a chain, wire or cord running over one or more pulleys usually supported on brackets rivetted to tanks or walls, and thence to an indicator which usually travels up and down a gauge board. The float-gauge has the advantages of being easy to install and operate, low initial cost and low maintenance cost.

The float-gauge has serious disadvantages, however. It is very liable to error. If made of wood its buoyancy is certain to lessen with use, due to penetration of preservative, which will affect gauge reading. If a cord is used to attach float to indicator the shortening or lengthening according to the varying humidity of the air will affect the gauge reading. If a chain or piano wire be used to connect the indicator and float, temperature changes cause changes in length of chain or wire, which may seriously affect reading. The aggravation caused when the chain or pulley sticks or indicator jams in the guides is experienced by all who use this kind of gauge. Volume corrections for temperature must always be made with this type of gauge, and while this is a very simple calculation it is just one more chance for the entry of the "human liability-to-error" factor.

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There is great difficulty in securing an accurate reading with such a gauge, because the indicator will rarely return to exactly the same point on gauge board if float is moved up and down by pulling on chain or cord to see that it is working freely over pulleys. This precludes the possibility of taking readings of any considerable degree of fineness. Water freezing in pulley bearings and indicator guides has been known to give similar trouble.

Scale Over Cylinders.

Another device which measures preservatives, and which has the advantage of giving direct readings, is that wherein the tanks of preservative are mounted on a heavy scale over the treating cylinders and the amounts determined directly by weighing. Of course, such an installation is comparatively very expensive, and it would seem that repairs and maintenance costs would also be comparatively very heavy.

The tanks which are supported by the platform of this ponderous scale have "ball-joint" or "flexible" connections with the necessary filling and discharge, and steam pipes, but it does not seem possible that these joints, which are rather cumbersome affairs, would move freely enough to secure a close reading. One scale of this type which was examined was graduated to read to 20 lbs., but it was not thought that a 20-lb. weight placed on the scale platform would change the reading on the scale-beam, and it was stated that when a charge was weighed over a track scale before and after treatment, the weight of preservative thus determined differed from that as shown on the tank scale by as much as 300 lbs or more; from this it would seem that it could hardly be claimed that a scale of this type is extra sensitive.

The mechanism of this type of measuring device is rather complicated, and it would seem that there would be danger of serious accident, due to possible breaking of filling or discharge pipes through failure or sticking of the flexible joints.

Mercury Gauge.

Two or more plants are using a measuring device which is very low in first cost, very simple, very easy to operate, has low cost of repairs and maintenance, is accurate, sensitive to any reasonable degree at will of operator, and gives direct readings by weight. It is known as the Mercury Gauge, and consists of a vessel of mercury connected to tank in such a way that the liquid presses directly on the top of the mercury. The outlet of the vessel holding the mercury is a glass tube of small bore low down at bottom or side. It is obvious that any pressure on top of mercury in container will force mercury through the outlet tube to a height commensurate with the pressure exerted. Now, as the specific gravity of the liquids to be measured is much less than that

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of the mercury, a comparatively high tank of preservative would raise the mercury in glass tube but a short distance vertically, therefore the glass tube is placed in a slanting position, and readings of any desired degree of fineness can be secured depending upon angle at which the tube is placed.

There are no volume-temperature corrections to make in using this gauge; it is cheap, sensitive and accurate; and it would seem to be deserving of investigation by plant operators and possible mention in the Association's recommendations in matters of standard practice.

Determining Cubic Feet Per Charge.

One detail of plant operation which is of greatest importance to all concerned is the determination of the number of cubic feet per charge. As it is a simple arithmetical calculation to find the number of cubic feet in a charge of sawed lumber, such as bridge timber, switch ties, etc., we will consider only the methods used to check up the number of cubic feet in a charge of ties.

In some places a small tank of known volume "V" is provided. A tie is weighed, placed in tank and tank filled with water to a certain mark, "V," high enough to cover the tie. The volume "V" of water required to do this is noted. The tie is then removed and weighed. The gain in weight is corrected to volume "V" of water, added to "V" and their sum substracted from "V" to give volume of tie. When this process has been repeated thousands of times a fair assumption can be made as to average number of cubic feet per tie. The disadvantages are the necessity for special apparatus, more or less complete, but which must cost something, the careful drying of tanks and piping each time used if doing close work, the necessity of bringing each tie to place where tank is located and removing tie again to tie yard, and labor involved in handling each tie in and out of measuring tank.

A similar method has been used, with dry sand as the volume-determining medium. This has the disadvantages of the foregoing method, save that it is not necessary to weigh the tie. In addition a quick means of handling sand in and out of tank must be provided. There is a question whether the voids in the sand would not throw out this scheme.

Another method in use at present is described as follows:

> The cylinder displacement is first determined by charging cylinder with 15 empty trams, closing the door and filling cylinder from treating tank. The reading is then taken on treating tank, the emulsion is then blown back from cylinder to treating tank and final reading taken. The difference between final reading and reading first taken represents the cylinder displacement (M), which is a constant and is used in determining volume of individual charges.

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To determine the actual cubic volume of each individual charge, the low point reading (C) is taken after releasing pressure; after emulsion is blown back from cylinder to treating tank the reading (D) is taken on treating tank before applying final vacuum. D minus C represents the volume of emulsion blown back. The figure obtained by substracting D minus C from the constant M will be equivalent to the volume of ties in that particular charge.

This method is used to some extent, but is it not open to serious criticism? Is it not true that after bulk of solution is blown from retort before applying final vacuum a considerable quantity of solution may be blown from ties?

Also that during and after the final vacuum a considerable quantity of solution is removed from ties which should be reckoned with?

The beloved dean of American wood-preservers, Mr. Samuel M. Rowe, gives the same method in his treatise, "Preservation of Timber," 1907 (Revised). On page 67, section 23, he says:

Close the retort, note the indicator reading on the solution tub, then open the main valve and entirely fill the retort with water, again reading the indicator, and the vertical feet used by the area of the tub will be the volume of the retort. It would be well to include such number of tram cars as are used in a charge of ties, as this will be used in case of ties at all times.

On page 76, section 23, he says:

To compute the volume of the timber in the charge: Take the lowest reading of the chloride indicator from the reading after the solution is fully forced back. This difference is the number of tub feet that was in the retort after absorption is completed, hence, when reduced to cubic feet, will be the number of cubic feet outside the charge, and taking this from the known volume of the retort, the remainder will be the volume of the charge in cubic feet of timber.

A method which is in use at present, which does away with the apparatus and labor charges of the water and sand methods, and eliminates the liability to error due to varying blowing back periods of the other methods, and one which checks itself surprisingly well, is as follows:

Several thousand ties may be measured for length only, and the average determined. Several such blocks of measurements, taken at different times throughout the year, have been found to check each other and further to meet the specifications under which the ties were purchased almost exactly.

The average length having been determined, it is an easy matter to measure both ends of each tie as it is loaded on trams, find the average area, multiply by the average length and compute the cubic feet in the tie. In the case of sawed ties this is obviously easy to do; in the case of hewed pole ties a little careful estimation is necessary. The method is as follows:

Refer to the sketch and note dotted line connecting the points

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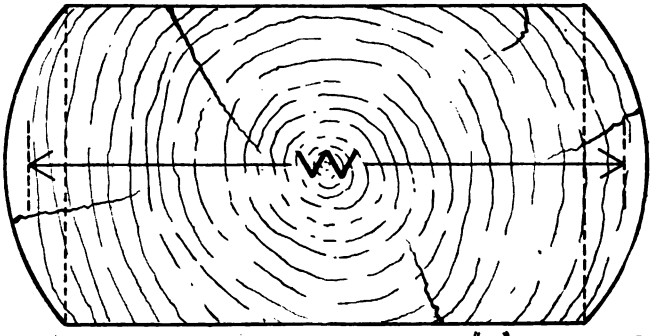
where the curved sides join the flat faces of tie. Notice a short dotted line between the first dotted line and outside circumference of tie; if this shorter dotted line is located with care by the operator he will have a close figure on the width of the tie. The width and thickness being thus found for each face, average area is easily determined and



METHOD OF DETERMINING APPROXIMATE WIDTH "W" OF POLE TIE.

number of cubic feet per tie is known. If thousands of ties are measured, as may be readily done as ties are being loaded on trams for treatment, we presently arrive at a very fair knowledge of the volumes of No. 1 and No. 2 ties, etc. We know how many No. 1 ties, or No. 2 ties, and whatever subdivisions may be in use at the various plants, constitute an average charge. Multiplying the number of No. 1's by the average cubic feet in a No. 1 gives average cubic feet per charge of No. 1's. Same with No. 2's, and whatever other divisions are in use.

Now, calculating the percentage of No. 1's and No. 2's, etc., which may be treated at a given place, and multiplying by the proper number of cubic feet per charge for each kind, we arrive at a fair average number of cubic feet per charge for all classes. Calculations have been made of several thousand ties, at different intervals, and the cubical contents per charge as determined in this manner, found to check very closely, not varying over 10 cubic ft. in 2,400.

Certainly we all want to know the best way to determine the number of cubic feet in a charge of ties; it is hoped that our older members will give the benefit of their opinions in discussion, and further, if feasible, that the Association as a body will take up all such matters, and fix certain methods and standards to which we can uniformly adhere until newer methods and standards are shown to be more consistent.

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THE PRESIDENT: Now, gentlemen, what is your pleasure? Would you like to have Mr. Grady's paper and discuss them both, or do you want to discuss this report separately? We will have Mr. Grady's paper next.

MR. W. H. GRADY: I think it advisable to state in this connection that in any general discussion on fuel economy the subject must necessarily be handled under three heads: First, the selecting and buying of the fuel; second, the design of the plant; and third, care and operation of the plant. If the proper method is not used in selecting the fuel you defeat to a great extent the object of the work.

SELECTING AND BUYING FUEL.

By W. H. Grady.

This is strictly a technical and engineering problem, and the one performing these duties should be qualified for selecting the most economical fuel available. In recent years the "Purchasing Engineer" has been used by some of the larger firms. This is a new field for the engineer that will be more fully recognized in the near future.

The kind of fuel to be used at any plant is to some extent determined by the plant location, and it should be selected before the design of the boiler plant, as the proper construction of the furnaces, grates, stacks, etc., will depend upon the kind of fuel to be used.

Kind of Fuels.—The principal steam fuels are gas, oil, coal and wood. The plant location will usually determine which one of these four classes of fuel will be used, but in some localities two or more of these fuels may be found in competition. The first step in selecting the fuel, then, will be to determine which one of the two or more available classes of fuel will be the most economical, after which it becomes necessary to choose between two or more available fuels in this class.

Calorific Value.—Every kind of fuel has a certain calorific value. This is expressed in British Thermal Units per pound for solid and liquid fuels and B. T. U.'s per cubic foot for gas. Ordinary steam coals vary from 10,000 to 15,000 B. T. U. per lb. Commercial fuel oil runs about 19,500 B. T. U. per lb. Air seasoned wood, containing about 25% moisture, runs about 5,824 B. T. U. per lb. The most common gas for boiler fuel is natural gas and byproduct coke oven gas. The heat value of coke oven gas varies around 500 B. T. U. per cu. ft., and that of natural gas from 750 to 1,200.

While, of course, a number of details must be considered in selecting the most economical fuel, the fundamental and most important item

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is the calorific value. The accepted standard units by which steam fuels are sold are:

Ton of coal.
1,000 cu. ft. of gas.
Barrel of oil.
Cord of wood.

East of Pittsburgh the long ton unit of 2,240 lbs. is used. West of Pittsburgh the short ton of 2,000 lbs. is in use. Wherever the expression "ton" is used in this discussion the short ton will be understood.

One barrel of fuel oil is understood to be 42 gals. and, for average oil, it weighs 7.4 lbs. per gal.

A pile of wood 4'x4'x8', or 128 cu. ft. gross, is known as a cord. The actual net cubic foot of wood in a cord varies according to the shape of the sticks. In this discussion it will be taken as 75 net cu. ft. at 38 lbs. per cu. ft.

Now the first question that enters the mind of the layman is how to compare the value of a cord of wood with a barrel of oil, or a ton of coal with 1,000 cu. ft. of gas, etc. This brings us back to calorific value, which must be the base of comparison between different fuels.

One ton of average bituminous steam coal will contain about 25,000,000 B. T. U. Therefore, it becomes quite convenient to compare the different fuels on the basis of "cost per 25,000,000 B. T. U."

It is usually advisable to buy fuel on contract covering one or more years, the fuel to be delivered as required in approximately equal monthly shipments. This insures the consumer with a steady supply of fuel at all seasons, and makes it unnecessary to carry large stocks in storage, which latter is undesirable on account of deterioration and danger of fire. When requesting propositions on fuel, information sheets, made up as per the following forms, should be furnished to and filled out by the fuel contractors:

PROPOSAL FORM FOR COAL.

1. Name of contractor.....
2. Grade of coal quoted.....
3. Location of mine; (a) Town.....
   (b) County.....
   (c) State.....
4. Mine located on what Railway.....
5. Best routing to.....
   (Point of delivery to be shown here by purchaser)
6. Freight rate to.....
   (Point of delivery to be shown here by purchaser)
7. Price per ton f. o. b. cars mines.....
8. Price per ton f. o. b. cars.....
   (Point of delivery to be shown as above by purchaser)
9. Proximate analysis on coal quoted:
   (a) Moisture .....%
   (b) Volatile combustible.... "
   (c) Fixed carbon..... "
   (d) Ash ..... "
   (e) Sulphur ..... "
   (f) B. T. U. per Lb. as Shipped

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PROPOSAL FORM FOR GAS.

1. Name of contractor.....
2. Location of wells.....
3. " " gas main (With respect to plant of purchaser)
4. Size of gas main.....
5. Pressure in gas main.....
6. Does your price include piping the gas into our plant and supplying the necessary meter and reducing valve? If not, state your point of delivery.....
7. Pressure at which gas will be metered to us at price quoted.....
8. Price per 1,000 cu. ft.....
9. B. T. U. per cu. ft.....

PROPOSAL FORM FOR OIL.

1. Name of contractor.....
2. Location of shipping point.....
3. Shipping point on what railway.....
4. Best routing to.....
(Point of delivery to be shown here by purchaser)
5. Freight rate to.....
(Point of delivery to be shown here by purchaser)
6. Price per barrel f. o. b. cars shipping point.....
7. " " " " " .....
(Point of delivery to be shown here by purchaser)
8. Weight per gallon at 60 deg. F.....
9. Flash point of oil.....
10. Calorific value, B. T. U. per Lb.....

PROPOSAL FORM FOR WOOD.

1. Name of contractor.....
2. Location of shipping point.....
3. Shipping point on what railway.....
4. Best routing to.....
(Point of delivery to be shown here by purchaser)
5. Freight rate to.....
(Point of delivery to be shown here by purchaser)
6. Kind of wood.....
7. Price per cord f. o. b. cars shipping point.....
8. " " " " " .....
(Point of delivery to be shown here by purchaser)

With this information in hand the following table of comparison should be prepared:

Name of Contractor	Kind of Fuel	B. T. U. per Unit (Lb. or Cu. Ft.)	Cost per Unit (Ton, cord, or M. Cu. Ft. in Boiler House)	Cost per 25,000,000 B. T. U. in Boiler House

A few simple examples are shown below illustrating just how to obtain the figures for the last column of this statement. Suppose proposals on all four fuels are received as follows:

Coal analyzing 13,000 B. T. U. per lb. at $1.75 per ton in the boiler house, oil analyzing 19,500 B. T. U. per lb. at 45c per barrel in the plant storage tank, wood at $1.50 per cord on the boiler house floor, and gas anaylzing 1,050 B. T. U. per cu. ft. at 7¼c per 1,000 cu. ft. in the boiler house.

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The cost per 25,000,000 B. T. U. for each of these fuels is:

1.75x25,000,000÷2000x13,000=$1.68 for coal
.45x25,000,000÷42x7.4x19500=$1.86 for oil (42 represents gallons per Bbl. and 7.4 the weight per gallon)
1.50x25,000,000÷75x38x5824=$2.26 for wood (75 represents the net Cu. Ft. of wood per cord, 38 the weight per Cu. Ft. and 5824 the calorific value.)
.0725x25,000,000÷1000x1050=$1.73 for gas

Tabulating these as per the above form, we have:

Name of Contractor	Kind of Fuel	B. T. U. Per Unit (Lb. or Cu. Ft.)	Cost per Unit (Ton, Cord, Bbl. or M. Cu. Ft. in Boiler House)	Cost per 25,000,000 B. T. U. in Boiler House
A	Coal	13,000	$1.75	$1.68
B	Gas	1,050	.0725	1.73
C	Oil	19,500	.45	1.86
D	Wood	5,824	1.50	2.26

From this we see that wood at the price quoted is not to be considered. The oil is also too high to be used as compared with the coal and gas. Considered strictly on the first cost of heat units delivered, coal would seem to be the best proposition. However, many other items must be considered before reaching any final conclusion:

1. A higher sustained boiler efficiency can be had with gas, due to no grate losses, clean boiler flues and easy regulation of air supply, low cost for banked boiler hours, easy regulation for varying loads, etc.
2. First cost for grates or stokers, furnace settings, etc., would be less for gas.
3. Maintenance costs and interest would also be less.
4. Fewer firemen are required for gas and no ash handling charges are involved.

These items alone, not to mention cleanliness from dust, soot and smoke, would throw the balance in favor of gas at even a higher price than that quoted.

All the advantages mentioned for gas would also apply for oil as compared with coal, except that more equipment would be needed for oil than for gas, such as storage and supply tanks and pressure pumps for feeding the oil burners. There would also be a nominal labor charge for unloading the oil.

Due to these reasons it is also cheaper to burn oil at a slightly higher cost per heat unit than coal, but as between oil and gas at the same cost per heat unit the gas would be more desirable.

Wood is the least desirable of all fuels, as it is hard to handle, takes up much room in storage or on the boiler house floor, hard to fire and requires large grate area for given boiler capacity. Of course, this refers exclusively to cord wood that must be purchased and not to waste at wood working plants where sawdust and shavings are handled by exhaust systems directly into the boiler furnaces at very low cost, making an excellent boiler fuel.

The conditions at all plants are more or less different and these must be known before final decision is made.

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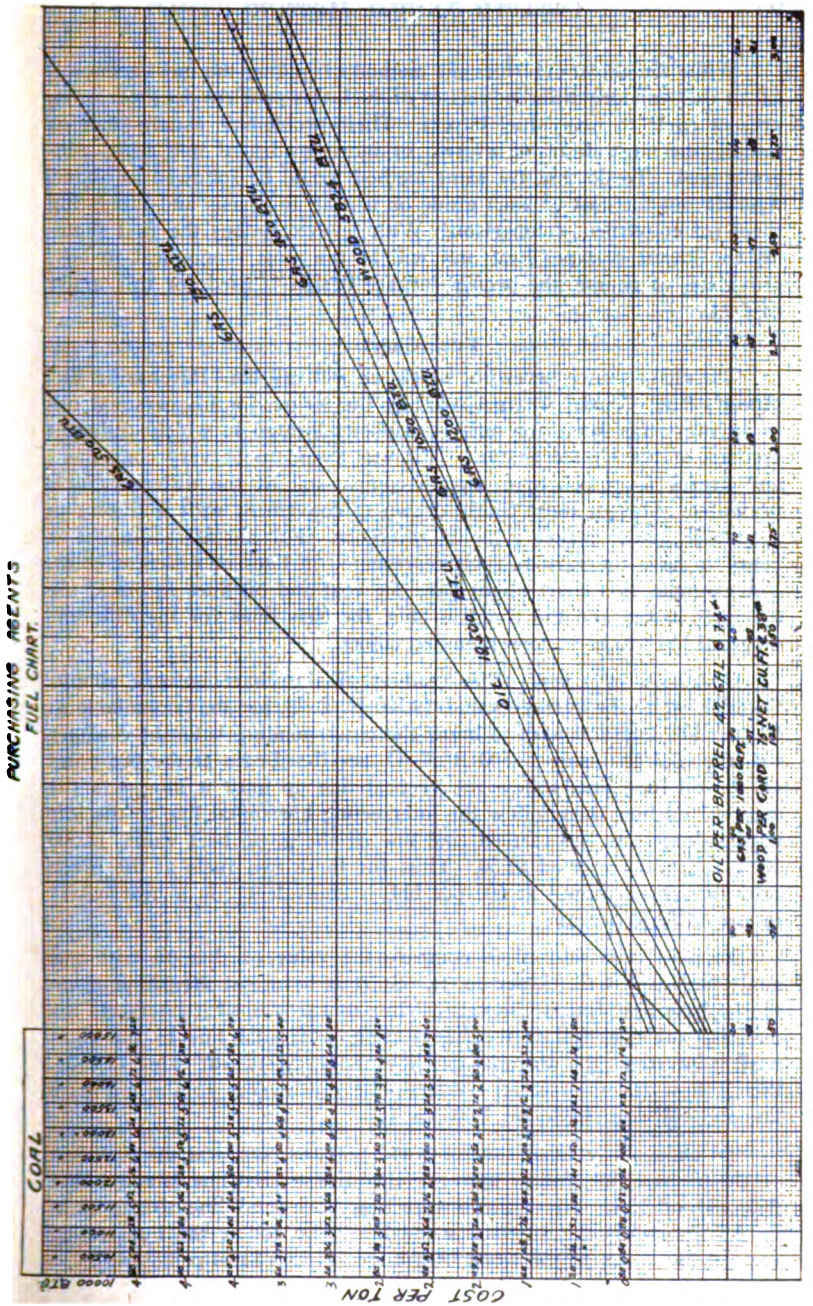
PURCHASING AGENTS
FUEL CHART
COAL
COST PER TON
OIL PER BARREL 42 GAL @ 7½¢
WOOD PER CORD 16 NET CU. FT. 2.38
GAS PER 1000 CU. FT.
GAS PER 1000 BTU
OIL PER 1000 BTU
GAS PER 1000 BTU
GAS PER 1000 BTU
GAS PER 1000 BTU

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While the above describes the method of finding the most economical of two or more different classes of fuel, this problem does not often present itself to many fuel buyers. Their problem is usually that of finding the most desirable of two or more grades of one class, generally coal. To do this, the same method would be followed as above, figuring out the cost of each grade on a heat unit basis and tabulating them for convenient comparison. With few exceptions the fuel showing the lowest cost per heat unit will be the most economical to buy, providing, of course, the proper furnace design is used for this grade of fuel.

Fuel Chart.

The chart shown herewith, which we will call the "Purchasing Engineer's Fuel Chart," was prepared by the writer for his personal use in buying steam fuels for numerous plants located in widely different sections of the United States. This was found to be very convenient and useful for quick approximate comparison of the different fuels presented. One of these charts drawn to convenient scale and kept in a suitable binder makes a handy reference. For aid in reading, it is better to have the various fuels represented in lines of different color. For example, this chart might have the coal and oil lines in black, the gas lines in red and the wood in blue, the base lines for the different diagonal lines to be in corresponding colors.

Operation of Chart.—The reading of the chart is very simple. Suppose oil of the average value, 19,500 B. T. U. per lb., is available at 60c per bbl. and you wish to know the corresponding value of coal per ton, the coal analyzing 12,500 B. T. U. per lb. Begin at the 60c point on the oil base line, follow the vertical line up until it intersects the diagonal oil line, then follow the intersecting horizontal line to the left until it intersects the vertical coal line of the given heat value, 12,500 B. T. U., and you read $2.50. Thus for these two fuels at the given calorific values, the oil at 60c per bbl. is equivalent (on a heat basis) to coal at $2.50 per ton.

Suppose it is desired to compare the value of this oil with gas analyzing 1,050 B. T. U. per cu. ft. Start as before at the 60c point on the oil base line, follow the vertical line upwards until it intersects the diagonal oil line, follow the intersecting horizontal line to the right until it intersects the diagonal gas line of the given heat value (1,050), then follow the intersecting vertical line downwards to the gas base line and you read 10½c per 1,000 cu. ft.

To make this comparison for wood, start as before at the 60c point on the oil base line, follow upwards until the vertical line intersects the diagonal oil line, follow the intersecting horizontal line to the right until it intersects the diagonal wood line, then follow the intersecting vertical line down to the wood base line and read $1.64 per cord.

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Thus, for the given known calorific values of the fuels, we have oil at 60c per bbl. is equal to the coal at $2.50 per ton, or gas at 10½c per 1,000 cu. ft., and wood at $1.64 per cord.

Suppose we have a gas analyzing 500 B. T. U. per cu. ft. at 3c per 1,000 cu. ft., how much could we afford to pay for a better gas analyzing say 1,200 B. T. U. per cu. ft. Start at the 3c point on the gas base line, follow the vertical line upwards until it intersects the 500 B. T. U. diagonal gas line, follow the horizontal intersecting line to the right until it intersects the 1,200 B. T. U. diagonal gas line, then follow the intersecting vertical line down to the gas base line and we read 7¼c per 1,000 cu. ft., thus the higher grade gas is worth 4¼c per 1,000 cu. ft. more than the lower grade.

The comparative values of the different grades of coal is readily seen by simply reading the horizontal line under the different grades of coal.

A little practice will show this chart to be very elastic in showing the relative values of the different classes or grades of fuel. Of course, these relations are based on heat value only and no allowance is made for the extra cost of handling required by some fuels. This will have to be figured out for the individual cases as described above.

Mine Location.

It will be seen that the proposal forms show the location of the mines. It is desirable to know this, chiefly in order to get an approximate check on the calorific values shown by the bidder before the final analyses are made by the buyer.

While, of course, there are cases where two mines very close together turn out coal differing very much in quality, still as a rule the coals from the different mining districts possess certain known qualities more or less distinctive of those districts. So by knowing the location of the mine of each bidder the buyer gets some approximate idea of the quality of coal he can expect from that point. He should also know this in order to check up freight rates, routing, transportation facilities, etc.

The Government has prepared some very valuable information on the fuels of the United States. Bulletins Nos. 22 and 85, issued by the Department of the Interior, give complete analyses of samples of coal taken in nearly every mining district in practically every coal producing State in the Union. In many cases the names of the actual mines from which the samples are taken are shown. In every case the county is shown. Reference to these records is a great aid in buying coal and every buyer of large quantities of coal should have these Bulletins in his files. They may be had free upon request to the Director of the Bureau of Mines, Washington, D. C.

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Final Analysis.

After determining, as above, the most economical fuel to buy, based on the analyses submitted by the contractors, it then becomes necessary to check up these analyses to see if the fuel which the contractor is actually producing comes up to these claims. The best way to do this is for the buyer to go to the mines of the two most likely contractors and take samples from cars of coal already loaded with the same class of coal proposed, these to be sent to a reliable testing laboratory for analysis. Another way is to order one or two sample cars and take samples from these after they are received. The first method is better, for when sample cars are sent they may be "picked" cars and not be representative of the average. And, furthermore, it is well for the engineer to visit the mines to see if the methods and equipment in use are good. After checking up the analysis in this way the purchaser is in position to close the contract.

Cost of Analyses.—There are a number of good reliable laboratories throughout the country where these samples will be analyzed for from $5.00 to $7.50 per sample, and the results obtained are well worth the costs.

In the previous discussions it was not supposed that the B. T. U. content of the fuel was guaranteed. The above methods of buying were to illustrate how the purchaser must proceed to locate and buy the fuel from which he could expect to receive the best heat values for the prices paid. It then becomes the duty of the operating man to watch carefully the fuel received and see that it comes up to what might reasonably be expected.

Occasional samples should be taken and analyzed. Sometimes a car will be received, from the general appearance of which it can be seen that it is not up to standard. When these conditions are found the shippers should be notified and requested to be more careful on future shipments. The writer has found from actual experience that excellent results will be had in this way, for when the shippers find they are being carefully checked on the quality of coal furnished they will be more careful than otherwise.

For the small plants, and possibly even for the large ones, we believe the results obtained by this method will be as good as when the fuel is bought on a strict B. T. U. guarantee, as in the latter case the expense of analyses on every car must be covered before the net saving may be counted.

American Coals.

The United States is abundantly supplied with good coals. While most of these coal fields are located east of the Mississippi River, some

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excellent coals are found west of the river, the best being the semi-bituminous coals of Arkansas.

Beginning with the bituminous fields of Pennsylvania, the quality of the coals seems to decrease gradually from that point to the Mississippi River, some of the poorest coals being found just east of the river in Illinois. However, some very good coals are found in Southeastern Illinois.

Classification of Coals.

Coals are classified as Anthracite, Semi-Anthracite, Semi-Bituminous, and Bituminous, the volatile matter increasing and the fixed carbon decreasing in the order named, anthracite containing lowest and bituminous the highest percentage of volatile matter, while bituminous contains the lowest and anthracite the highest percentage of fixed carbon. Placed in the order of their calorific values, these coals would stand: Semi-Bituminous, Semi-Anthracite, Anthracite and Bituminous, decreasing in order from Semi-Bituminous to Bituminous.

Coal Fields.

Named in the order of the calorific values of the coals produced, the writer would show the principal coal fields of the United States in the following order:

Order	*Fields*	*Class*
1	Pennsylvania	Anthracite, Bituminous and Semi-Bitu.
	West Maryland	Semi-Bituminous
2	West Virginia	Bituminous and Semi-Bituminous
	West Arkansas	" "
	Eastern Kentucky	"
3	Central Alabama	"
	Ohio	"
4	Western Kentucky	"
	Southwestern Indiana	"
	Southeastern Illinois	"
5	Central & Eastern Ill.	"
	Missouri	"

THE PRESIDENT: That is an excellent paper. Now, gentlemen, you can discuss the report of the two members of the Committee on Plant Operation or the paper on fuel, or both. Who is the first man on the floor?

MR. C. P. WINSLOW: I have just a few comments on Mr. Grady's most interesting paper. I will be brief and confine my remarks to wood. In considering the calorific value of wood it is well to remember that it is primarily based on the oven-dry weight of the wood. Generally speaking, a pound of wood, bone-dry, with all the moisture removed, has practically the same calorific value for any species. Of

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course, if the wood contains appreciable quantities of resin it will affect the result, since the calorific value of resin is considerably greater than. The effect of moisture also has an important bearing. The more moisture that you have in your wood the more of those heat units have to be used in evaporating that moisture. Roughly, for every 10% of moisture it takes 12% of your heat units to get rid of it. The British thermal units in a pound of dry wood number about 7,700. Hence, if you have 25% moisture; in other words, if you have a pound of dry wood plus 25% of moisture that would mean that 30% of your available heat units would go in evaporating the moisture when using it for fuel, and that would cut down the effective B. T. U.'s to about 5,400. If there were 35% moisture, or 50% moisture, the effective heat units would naturally be proportionately less. The figure of 5,400 B. T. U. is close to the one quoted by Mr. Grady, and the slight difference might be accounted for by a different basis of rating moisture.

Aside from the foregoing, there is an even more important point to be considered in determining the calorific value of a cord of wood. Let us suppose that wood is being purchased on a cord basis. Mr. Grady used in his curve a figure of 75 net cubic feet of wood in a cord. It would be recognized, of course, that a cord is a very variable unit as far as the quantity of wood is concerned. You may get much more than 75 cu. ft. in a cord, and, on the other hand, possibly less. The actual amount of wood will vary considerably according to the size of the sticks and method of piling. Hence the character of the wood that goes into a cord, form and dimensions, method of piling, etc., will have a very appreciable effect on the calorific value of a cord.

Another point of importance lies in the question of the species. While the calorific value of a pound of dry wood of different species is about the same, it evidently cannot be the same for equal volumes of different species. There will be more pounds in a cord of heavy wood than in a similar cord of a lighter wood. For example, the dry weight of spruce is about 22 to 25 lbs. to the cubic foot, while the dry weight of hickory is about 45 lbs. per cubic foot, so that with a cord of spruce and a cord of hickory that were exactly similar as regards dimensions and size of wood, moisture content and method of piling, the calorific value of the hickory would be approximately twice as great as from the spruce.

Possibly many of those points are already generally recognized. I am sure they are by Mr. Grady, and I merely wanted to emphasize them because in using his chart most effectively it is necessary to keep those points in mind. Thank you (applause).

MR. W. H. FULWEILER: Mr. President, in connection with Mr. Grady's very excellent paper on the purchase of various kinds of wood for boiler firing I would like to emphasize the fact that the vary-

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ing efficiencies of the different fuels and the labor costs of handling them is frequently as quite important as the actual cost per unit of calorific value, as for instance, the difference between gas and wood. I think with respect to coals that Mr. Grady has not called attention to an exceedingly important factor. That is, the ash. It seems that with our modern desire for efficiency it is very frequently desirable to push boilers to considerably over their rated capacity. When you begin to push a boiler up to 150% to 250% of its rating, the character of the ash of the coal becomes an exceedingly important one.

In connection with the ash you must consider whether the boiler is to be hand-fired, or stoker-fired, and this is on account of the fusing temperature of the ash. We must further differentiate it into an ash that has a sharp, quick point of fusion and an ash that is what we call "sticky;" in other words, that starts to soften at a rather low temperature, but does not completely fuse until it reaches a relatively high temperature. In some coals the ash may not soften until it is within a few degrees of the point of fusion. Now, the point is that if we have an ash that is sticky it balls up in the fire, particularly when the fire is being pushed, and the stoker simply cannot handle it at all. On the other hand, in hand-firing the fireman has a very considerable amount of difficulty in handling his fire. He "loses" the fire, as he calls it. It gets all gummed up, with a sticky sort of clinker. He cannot pull them out, or if he does he pulls the bulk of his coal out. This question, therefore, of the fusibility of the ash or the fusing temperature of the ash and the nature of its fusion are points that are being given a very considerable amount of attention at present, especially in plants that are being driven at high capacity.

With reference to getting the name of the mine from which the coal is presumed to be derived, I think Mr. Grady is a little optimistic about the amount of help it is going to give him regarding the quality of coal that he will get during the year. As neighboring mines frequently vary quite widely, it has been our experience that it is very difficult to trace back any particular car to any particular mine. We have endeavored to do that on some occasions, and find great difficulty in so doing. The coal is usually shipped from a certain region, and that is about all the information you can get from your railroad. They seem to be very averse to giving you any particular point of origin. I would suggest, however, that a visit to the mine would serve this very important purpose. After you get up there and make the proper local inquiries, you can frequently find out whether the firm that proposes to furnish this coal is physically able to make delivery, and what general state they are in regarding the supply of cars; because I find that of even greater importance than the B. T. U.'s delivered is the ability to get coal when you need it throughout the year.

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MR. W. H. GRADY: I just want to state that almost every item brought out in this discussion was covered in the paper. In the first place, I said that while the location of the mine gave you some approximate idea of the heating value of the coal, it did not determine the difficulty. Suppose, for instance, you were located in Illinois, and wanted to buy some coal, and all the sales offices here in Chicago know that if one man's mines are located in Eastern Illinois and another man's mines are located in the western part of Illinois along the Mississippi River, they know right away that the coal coming from along the Mississippi would be high in ash, high in sulphur, which would make it clinker in your stokers and give you a lot of heat value, while the coals coming from Southeastern Illinois would be a very much better grade of coal. Of course, that does not always follow, but sometimes that is quite a help.

MR. M. K. TRUMBULL: I had occasion about a year ago to learn how some of the big companies here in Chicago buy coal. I understand the Commonwealth Edison Co. have entirely changed the basis of purchasing from the "B. T. U." or calorific value to a basis of where the coal comes from. They know just what the situation is in the coal fields. All they want in their quotations from the producer, in addition to the price, is to learn where the coal is shipped from. This paper we have just heard is a splendid one. I was pleased a year ago when we had a paper by Mr. Lockett which brought up points that we, as operators, should be posted on. I appreciated Mr. Lockett's discussion, inasmuch as I had just begun, in our own company, to make an effort to reduce the fuel consumption. Mr. Lockett's paper reinforced some of the ideas I already had started to work out. We were rewarded by cutting our fuel bill in two by following a carefully developed plan. There are two or three questions I would like to ask Mr. Grady. First, Has the scope of his investigation included petroleum coke?

MR. W. H. GRADY: No. I have not had any experience with petroleum coke.

MR. M. K. TRUMBULL: Then I will not ask the other questions. Thank you.

THE PRESIDENT: Is there anyone else who wants to discuss this paper?

MR. C. N. FORREST: Mr. Chairman, I would like to add a word in regard to oil fuel; wood and coal having been discussed by others. Nineteen thousand five hundred B. T. U.'s rather impresses me as being somewhat above the average for fuel oil, especially in the East, and inasmuch as wood fuel is valued in pounds per cord, according to the kind of wood, so will oil fuel vary as to the number of

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pounds per gallon. While 19,500 B. T. U.'s per pound for 7½ lbs. per gallon of oil is mentioned and seems rather high, it does not figure out as high per gallon as an oil that will weigh, say 8.3 lbs., or about 1 gravity. This latter only runs 18,500 B. T. U.'s, and it seems to me that a better basis of valuation for a fuel oil would be by the gallon, inasmuch as it is bought by the gallon and is burnt by the gallon than it would be to estimate its B. T. U.'s by the pound. As it stands here, 19,500 B. T. U.'s for a 7½-lb. oil amounts to 146,250 B. T. U.'s per gallon, whereas 18,500 B. T. U.'s per pound for 8.3 lbs. of oil is 153,550 B. T. U.'s per gallon. It is customary, however, to buy fuel oil on the B. T. U. per pound basis, rather than by the gallon, and it has always seemed rather misleading to me and somewhat unfair. There are a great many fuel oils in the East that run considerably higher than 7½ lbs. per gallon at the present time.

THE PRESIDENT: Is there anyone else who wants to discuss this paper? Mr. Trumbull has gone out, but I wish every operator would remember what he stated, that they were able to cut down their fuel expense 50%. It shows what can be accomplished if we look after the fuel. I am not going to discuss this paper, but I am going to make a statement. About a year ago I was riding from Chicago to Galesburg, and I met a gentleman who is operating a plant,—if I remember rightly a glucose plant at Keokuk,—but it is immaterial. He had a plant that they used to burn 120 tons of coal a day. They went after it scientifically, and they reduced the amount of coal burned to 40 tons and less; that is, it averaged about 36 to 37 tons per day. When it got above that, when it reached 40 tons, he went after the fellow that was looking after the coal. He kept a scientific man there all the time just to watch the coal. You can see if he only paid 75c. per ton for his coal and 75c. for freight, that he had a large profit just in looking after the amount of fuel burned. I think this Association should be very thankful to Mr. Grady for the paper, the most excellent paper which he has given us.

Now, we will pass to Mr. Lembcke's paper, but before we pass to that I want to make a statement.

The Chairman of Committee No. 1 is not here. We want those of the Committee who are here to be prepared tomorrow morning to present us something on preservatives. Mr. Fulks, I understand, would like to meet the members of that Committee.

MR. E. B. FULKS: No, I do not know of any occasion for meeting the membership of the Committee, but there will be an incidental report ready to make some time tomorrow; whether it will be tomorrow morning I cannot say, because this is a part of a joint committee of two other associations, and they are going to have a meeting some time tonight or in the morning. Whatever I do must necessarily come

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after that, so I hope to have something ready some time tomorrow. The rest of the Committee on Preservatives is not interested in it.

THE PRESIDENT: I wanted to notify the members so they would know what to expect. Now, we will have Mr. Lembcke's paper.

THE FOREIGN CREOSOTE OIL SITUATION.

By G. A. Lembcke.

During the months immediately following upon the outbreak of the European war it looked as if all shipments of creosote oil from Europe were definitely and suddenly stopped. The British, as well as German Governments, immediately placed an embargo on the exportation of creosote oil on the grounds that they needed it for their own purposes.

In Germany, the embargo still exists, while in Great Britain it was found that the fact that the British creosote oil solidifies unless kept at a temperature of about 90°F. made its employment for the purposes originally intended impossible, and the embargo against exportation was consequently withdrawn. Even then, as the British Admiralty had commandeered for their own purposes practically all available tank steamers, the question of transportation from the United Kingdom to the United States offered serious difficulties.

As time went on, however, it was found that the tar distillers in Great Britain were called upon by the Government to make deliveries of coal-tar products for the purpose of manufacturing war material. Incidental to supplying this demand, increased quantities of creosote oil were produced and subsequently accumulated in the available storage tanks of the distillers. Thus gradually a situation arose where the distillers' creosote storage needed relief in order to enable them to meet the Government's continued demands for coal-tar products for ammunition manufacture. Confronted with this situation the British Admiralty finally consented to relieve the storage by releasing from time to time, as needed, tank steamers for the purpose of conveying from the accumulated stocks creosote oil from the United Kingdom to the United States. The result of this action was that during the second half of 1915 shipments to this country were made in larger volume than during the early part of the year.

While under present conditions, on account of the censorship and other precautionary regulations in Great Britain, it is more difficult to secure exact records and figures, from the information available and at hand it can be estimated that the shipments of creosote oil from the United Kingdom to this country during the year 1915 amounted to about 30,000,000 to 35,000,000 United States gallons. Compared with

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importations of foreign creosote oils during 1912 of approximately 60,000,000 U. S. gallons; during 1913 of approximately 55,000,000 U. S. gallons, and during 1914 of approximately 43,000,000 U. S. gallons, the above importations naturally show a considerable decrease.

It must be considered, however, that this year's total imports excludes all German and Belgian oils, and that the total volume of importations for 1915 consisted of British creosote oil only. Due to the fact that several of the large railroad systems on account of uncertainty of supplies, decided to abstain for the time being from the use of creosote oil, as well as to the depressed general conditions in this country, particularly during the early part of 1915, the importations during 1915 sufficed to meet in a measure the somewhat decreased demand.

How the position is going to shape itself during the year 1916, or even beyond that, of course, remains to be seen and is largely dependent on the duration of the war. If the war should be protracted for another year German and Belgian supplies will not be available for importation. The loss, however, will in all probability be slightly offset by an increased quantity of creosote oil available for shipment in the United Kingdom where as a result of the increased demand for coal-tar products a good many byproduct ovens have replaced the old beehive ovens. It must, however, not be assumed that such possible increase in the production of Great Britain be sufficiently large to totally offset the loss caused by the falling off in Continental quantities.

The law of supply and demand suggests that prices for foreign creosote oil in this country will remain about on the present level as long as conditions are as just outlined. Even should the war end some time during 1916 it is not reasonable to suppose that a decided change in price will take place.

Stocks in Germany are entirely exhausted, and export of creosote oil after the war must of necessity at first at least be slow and reduced in volume. In Great Britain and the other countries involved in this war an immense amount of renewal work must be done after peace is declared, and, therefore, European consumption will be increased while the total output of creosote oil probably will assume ante bellum proportions.

THE PRESIDENT: Has anyone anything to say on this paper? Dr. von Schrenk, do you want to say anything on this paper?

DR. H. von SCHRENK: The only thing I can say, Mr. President, is I wish it had been a little more optimistic.

THE PRESIDENT: We will now have Mr. Van Metre's paper on "Woods Suitable for Cross Ties."

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WOODS SUITABLE FOR CROSS TIES

By R. Van Metre.

A list of woods suitable for cross ties might fairly embrace, with few exceptions, every species that grows in commercial quantities.

One group consists of the woods that are generally recognized as being sufficiently durable without preservative treatment, and includes the white oaks, black locust, walnut and cherry, sassafras, mulberry, chestnut, cedar, heart longleaf pine and bald cypress. To this list some railroads add all red gum and all red beech. Other roads eliminate certain minor species and include them in the group acceptable for treatment.

The other group consists of the woods requiring preservative treatment, and this group is worthy of our constant study, for from it will come the future tie supply; and in it, as wood preservers, we are most interested. In this group may be included, with few exceptions, every species that grows in commercial quantities, as before stated.

In considering the value of any species for a tie, aside from the natural durability and its capacity for treatment, there are three points of importance:

(1) That it be sufficiently strong to withstand the ordinary strains due to center binding, etc.

(2) That it be sufficiently dense to resist spike pulling and lateral pressure on spikes; and

(3) That it be sufficiently hard to have a proper resistance to rail wear.

It is desirable that some classification of the mechanical suitability of the different species as ties be established from a comparison of their mechanical properties. The Forest Products Laboratory has been working on this, and has suggested the practicability of basing a classification upon a composite figure involving the following mechanical properties:

1. Static bending:
   a. Modulus of rupture.
   b. Fiber stress at elastic limit.
2. Impact bending:
   a. Fiber stress at elastic limit.
3. Compression parallel to grain:
   a. Maximum crushing strength.
   b. Fiber stress at elastic limit.
4. Compression perpendicular to grain:
   a. Fiber stress at elastic limit.
5. Hardness:
   a. End hardness.
   b. Side hardness.

Such a method using the results secured in the many thousands of tests conducted at the Laboratory on small clear specimens, and com-

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bining the data on a basis which would seem to give to the different properties a proper and reasonable weight in the composite figure, would result in the following classification of some well known species:

TIMBERS ARRANGED IN ORDER OF THEIR MECHANICAL VALUE AS TIES.

No.	Species.	Average Composite Value.
1	Black Locust	1666
2	Sugar Maple	1140
3	White Oak	1050
4	Red Oak	972
5	Beech	955
6	Longleaf Pine	914
7	Red Gum	825
8	Shortleaf Pine	800
9	Western Larch	790
10	Tamarack	740
11	Eastern Hemlock	700
12	White Fir	610
13	Lodgepole Pine	590
14	Western Yellow Pine	560
15	Northern White Cedar	420

In using such a classification, the variability of timber must always be considered since the strength of any given species may vary widely. The figures given are for average forest grown material and individual pieces of any of the species may vary as much as 30% above or below the average.

The idea of attempting to develop a standard table of this kind based on a large number of mechanical tests is worthy of careful consideration. It can be enlarged to include every species which is available in sufficient quantities, and I believe, would be of considerable value to anyone facing the situation caused by the decreasing supply of the oaks. The table is presented for your consideration in the hope of bringing out a discussion as to its probable usefulness.

In addition to the mechanical properties, an important factor in determining the suitability of any species as tie material, is the question of how a wood undergoes seasoning.

A few years ago the specifications of many of the roads required that ties be winter cut—between October 1 and March 1—but in most cases this requirement has been eliminated or entirely ignored. I believe if that requirement had been rigidly insisted on, with regard to the so-called softwoods, such truly serviceable woods as beech, gum, the maples, birch and elm, would be standing favorably with the red oak group, instead of having yet to prove their merit. Summer cut ties of these species are subject to the severe checking and deterioration by incipient decay before treatment that winter cut ties escape to a great extent.

The solution of the problem of handling these softwoods is simple in theory, though more difficult in practical operation. It requires two

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things: Rigid restriction of the cutting period to the months between October 1 and March 1, and the proper piling of ties for seasoning at every stage from the woods to river bank or right-of-way to the treating plant yard. Unfavorable results from treated ties made of these woods can usually be traced to failure to observe these precautions.

It is generally conceded that red oak is the very best wood for ties. It is strong, easy to treat, easy to handle to avoid deterioration before treatment, hard to resist rail cutting and spike pulling. For these reasons, all concerned would gladly limit their operations in treatment ties to this wood, if there were sufficient timber available to supply the demand. But the red oaks for ties are fast going the way of the white oaks. The so-called inferior woods must make up the shortage, and of these, the timber supply and rate of growth will take care of the demand for many years.

It is not too early to begin to conserve the supply of red oaks for future use in track where the service is severe. This can be accomplished by letting down the bars to other woods on their merits as proved in the test tracks maintained by most large roads that are most earnest in efforts to determine each wood's value as tie material.

It is only a matter of time when every wood having the requisite mechanical properties will be used for ties. That time will come when the producers and consumers of ties cooperate to control the period of cutting and method of seasoning, so that ties will reach the treating plant with their natural condition unimpaired by checking and incipient decay.

THE PRESIDENT: Gentlemen, who knows all about the various woods that we ought to use for ties? Mr. Moses, you are smiling; what have you to say about it?

MR. L. B. MOSES: I am smiling because you asked such a question (laughter).

MR. C. P. WINSLOW: Mr. President, I had planned a discussion on this paper, with some charts to go with it, to illustrate some features of the method of classification referred to in the paper as being worked up at our laboratory; but expecting the paper to come tomorrow, my blue prints and papers are now at the LaSalle Hotel. I would be very glad to bring them over tomorrow should you care to have them presented. I will accept your orders on that, Mr. President.

THE PRESIDENT: We will be very glad to give you an opportunity to bring out your blue prints and discuss this paper. Is there anyone else that has anything to say on this? If not, we will have Mr. Goltra's paper, but before we have it I want to make one or two announcements. First, after his paper we will have reports from Stand-

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ing Committees 8, 9 and 10, Mr. Angier, Mr. Schnatterbeck and Mr. Howson. I want Mr. Card to make an announcement.

MR. J. B. CARD: I would like to have Mr. Teesdale make the announcement.

THE PRESIDENT: Mr. Teesdale, will you make the announcement in regard to Dr. Shackell.

MR. C. H. TEESDALE: Dr. Shackell will be here tomorrow morning, and will describe some experiments he has been conducting on marine wood borers in co-operation with the Forest Products Laboratory. We have obtained some very interesting results in the action of marine wood borers on creosoted wood, and I am sure you will be interested in hearing Dr. Shackell's talk.

THE PRESIDENT: Will he need a stereopticon?

MR. C. H. TEESDALE: I do not think that he expects to use one.

THE PRESIDENT: Now, another announcement that I want to make. Dr. von Schrenk is going to give us a stereopticon. I am sure you will all want to hear him. That will be tomorrow afternoon. I am making these announcements so that if you have any special engagements you will be here when those two gentlemen talk because I think that both of them know what they are talking about. Sometimes some of us talk, and we do not know what we are talking about, but they do.

We will now hear Mr. Goltra's paper.

QUANTITY OF ZINC CHLORIDE PER TIE OR PER CUBIC FOOT OF TIMBER, AND METHOD OF DETERMINING THE TRUE STRENGTH OF THE SOLUTION.

By W. F. Goltra.

There is a divergence of opinion among users of zinc chloride, regarding the strength of the solution and the quantity of dry salt that should be injected per tie, or per cubic foot of timber, to thoroughly protect the wood from decay. It has been almost the universal custom in this country to specify a certain quantity of dry salt per tie, or per cubic foot of timber, without taking into consideration the variability in the absorption of the solution by individual pieces of timber in the same charge, or the species of wood under treatment.

It has been clearly demonstrated, and it is an accepted fact, that the absorption of individual ties in the same charge varies greatly, depending upon many factors, such as species of wood, degree of dryness, size of tie, etc. Many experiments have been made to find some way of

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securing a uniform absorption by individual ties in a cylinder charge, such as separating the various species of wood and treating each species separately, sorting of ties upon arrival at the plant according to their degree of dryness, etc., all of which has proven quite useless to achieve the desired end—namely, a uniform absorption of the preservative by individual ties in the same cylinder charge.

In practice it has been found that when ties are treated to refusal the quantity of zinc chloride solution absorbed varies from 10 to 50 lbs. per tie for oak, from 20 to 65 lbs. for beech, and from 30 to 90 lbs. for loblolly or soft pine, when ties are seasoned in open air and treated in the usual manner. Therefore, the average absorption for oak is about 30 lbs., for beech about 42 lbs. and for pine about 60 lbs. per tie. Suppose we are treating these three kinds of wood with a solution 3% strong; that is to say 3 lbs. of dry salt dissolved in 97 lbs. of water, the individual ties will absorb the following quantities of dry salt.

ABSORPTION OF ZINC CHLORIDE PER TIE.

of Wood. Species	Solution. Pounds.		Dry Salt. Pounds.	
	Range.	Average	Range	Average.
Oak	10 to 50	30	.30 to 1.50	.90
Beech	20 to 65	42	.60 to 1.95	1.26
Pine	30 to 90	60	.90 to 2.70	1.80

Thus it will be observed that some ties will absorb as little as .30 lb. of dry chloride salt, while others will absorb as much as 2.70 lbs. per tie. It is probable the average of all would figure 1.5 lbs. per tie, but that is manifestly not the proper way of specifying the quantity and strength of zinc chloride that should be injected into timber. It is neither accurate nor scientific, and is purely guesswork.

Instead of specifying so many ounces or pounds of dry salt per tie or per cubic foot of timber it would be more rational to base the strength of the solution on degrees Beaumé—at a stated temperature. The temperature of the solution should be taken into consideration to arrive at the true strength of the solution. In the heavier solutions, say 30 to 60% strong, the influence of temperature is small, so that no account need be made of it, but with that highly diluted, it is necessary to define the effect of temperature very carefully to get true measurement of strength. No more satisfactory means has been found for testing the strength of chloride solution than the Beaumé hydrometer, using the coarse hydrometer, 1° to 60°, for the concentrated solutions, and the fine hydrometer, 1° to 6°, divided to 0.1°, for highly diluted solutions.

The degree of dilution recommended by Sir William Burnett is one part by volume to 50 parts of water; that is equivalent to 2%.

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The late Samuel Rowe, who perhaps had as much experience as any man in this country in the use of zinc chloride, professed to have demonstrated that ¼ to ⅓ pound of zinc chloride salt per cubic foot of pine timber was sufficient to protect it from decay and any larger quantity would simply be wasted. European railways specify both the strength of solution and the quantity of salt per cubic foot. Generally the degree of strength is specified, according to the Beaumé hydrometer at certain temperatures. For example, the specifications of the Imperial Railways of Alsace-Lorraine, Germany, and the Bavarian Railways read thus:

> The solution must have a strength of 3.5 Beaumé—1.0244 specific gravity at a temperature of 15° C. (59° F.)

The Prussian Railways' specifications read thus:

> The solution must have a strength of 3.0° Beaumé, at 14° Reaumer (63° F.)

The percentage of strength of solution commonly used by European railways is, therefore, between 2½ to 3%.

In addition to these requirements, the above railways, in order to make the impregnation of the wood as thorough as possible, require that all species of timber shall be air-dried to a degree that they will absorb ½ lb. of dry salt per cubic foot of timber. But if that be not possible, because the wood to be impregnated is green or exceptionally dense, then the zinc chloride solution must be so strengthened that the absorption will amount to ½ lb. of dry salt per cubic foot.

Why it is necessary to inject a fixed quantity of dry salt per cubic foot of timber, regardless of its penetration into the wood, is beyond our comprehension. It follows, that if, for example, the ties are only dried sufficiently to absorb an average of 10 lbs. of solution per cubic foot, and it is necessary by terms of the contract to inject ½ lb. of salt per cubic foot, the solution would have to be made 5% strong, and perhaps the penetration of many of the ties would be very shallow, leaving nearly all of the interior of those ties untreated.

In our opinion, the strength of the solution, according to the Beaumé hydrometer at a certain temperature, should be the foundation of our specifications for treating wood with zinc chloride.

The strength should be sufficient to prevent decay, and possibly a little more, to make up for any loss on account of leaching, which might occur in the course of time. It should also be borne in mind that this can be overdone, and there is danger of making the solution too strong and injure the fiber of the wood.

In the year 1863, the Philadelphia, Washington and Baltimore Railroad built a Burnettizing plant and treated several thousand beech ties with zinc chloride. It was reported that the ties were as "brittle

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as carrots." The brittleness was ascribed to the use of a too strong solution. The strength of the solution is not stated, but it is said to have been about 6%, which, on the basis of an average absorption of 42 lbs. per tie, would be equivalent to 2.52 lbs. of dry salt per tie. It is no wonder they were brittle.

Many of the specifications in this country, covering the treatment of ties with zinc chloride, call for an injection of a mean between these extremes, namely, an average of ½ lb. of dry salt per cubic foot of timber, or 1½ lbs. per tie. In treating oak ties having an average absorption of 30 lbs. the strength would be equivalent to 5%; for beech with an average absorption of 42 lbs., 3.6%; and for pine with an average absorption of 60 lbs. per tie, 2.5% strong. Some specifications in this country, like those of European railways, specify a certain quantity of salt per cubic foot, regardless of the quantity of solution absorbed by various kinds of ties in all stages of seasoning, and furthermore, when the average absorption of the solution of a certain specified strength is not enough to conform to the requirements of the contract, the strength is so manipulated that the required amount of dry salt is injected. In other words, should a cylinder charge of ties absorb only an average of 30 lbs. of solution per tie, and the contract demands an injection of 1½ lbs. of salt per tie, the strength of the solution is increased to 5%, notwithstanding much of the preservative may remain on the outer shell of the ties. The strength of the solution when employed with soft porous woods, might, at times, be so low as not to treat the wood effectually, or with hard resistant woods might be so high, as to endanger the strength of the fibre of the timber.

It must be manifest to any fair-minded person that it is impossible to comply literally with specifications that require the injection of a specific quantity of dry salt in each and every tie. The individual variation in absorption by different kinds of wood must not be ignored in the solution of this problem. Many people have been led to believe that ties of all kinds absorb an equal amount of preservative, whether it be creosote oil, zinc chloride, or any other preservative. That is not true. No matter what process or method is employed to treat the ties, or what kind of preservative is used, there will always exist a very wide variation in the quantity of preservative absorbed by individual ties in every charge, and a big variation in the average quantity absorbed by ties manufactured from different species of wood, and different degrees of seasoning. If it has not yet been found possible by any practical method to inject into each and every tie an equal quantity of preservative, what is the sense of specifying a fixed quantity of salt for each and every tie, when it is physically impossible to carry out such specifications? The strength of the solution should be fixed and not the quantity of dry salt per cubic foot of timber. Some ties may absorb but little, others a great deal, but the strength of the solu-

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tion should be the same for all. The strength of the solution might be expressed in degrees Beaumé at a stated temperature. As the true strength varies with the temperature of the solution, it may be determined readily by a Beaumé hydrometer and the accompanying table prepared by the author. This table gives the true strength of the solution for different degrees of temperature and with different percentages of dry salt.

To illustrate: Take a sample of the solution in a glass. Drop a Beaumé hydrometer in the glass and take the reading. Then place a thermometer in the solution and take the reading. Find the temperature in the left hand column and follow the horizontal line until you find the quantity nearest to the hydrometer reading. Then at the top of that column you will find the true strength of the solution.

Thus, suppose the hydrometer reading is 3.50° and the temperature of the solution is 70°, the true strength of the solution will be 3%. Three per cent. means that 3 lbs. of dry salt was dissolved in 97 lbs. of pure water.

Instead of following the old custom of specifying so many pounds or ounces of dry salt or zinc chloride per cubic foot of timber, or per tie, it would, in our opinion, be more accurate, more definite and more scientific to base the strength of the solution on degrees Beaumé at a stated temperature.

Therefore, the author offers the following specifications for your consideration:

The zinc solution must have a strength of 3.50° Beaumé at a temperature of 70° F. The same strength shall be used for all species of wood and for all sizes of ties, and shall be injected into the wood to refusal.

THE PRESIDENT: Gentlemen, you have heard the paper. Does anyone want to discuss it?

MR. AUGUST MEYER: Mr. Chairman, Mr. Goltra says in his paper that oak absorbed about 10 to 50 lbs. per tie, and beech from 20 to 65 lbs. per tie. I rather think Mr. Goltra's figure is misleading, because it is a well-known fact that beech does not absorb solution nearly as readily as red oak, and all the tests I have ever seen have proved that. With the exception of white oak, beech is the hardest wood we have to treat, as it is almost impossible to impregnate the heartwood.

MR. L. B. MOSES: Mr. President, it seems to me that if the premises upon which Mr. Goltra's paper is based are correct there is

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TABLE TO DETERMINE THE TRUE STRENGTH OF ZINC CHLORIDE SOLUTION BY HYDROMETRIC READINGS AT VARIOUS TEMPERATURES.

Temp. Deg. Fahr.	Strength of Solution						
	1%	1½ %	2%	2½ %	3%	3½ %	4%
30	1.50	2.18	2.86	3.54	4.18	4.86	5.50
35	1.47	2.15	2.81	3.48	4.11	4.77	5.42
40	1.43	2.08	2.75	3.41	4.03	4.68	5.32
45	1.39	2.03	2.69	3.33	3.95	4.59	5.22
50	1.35	1.98	2.63	3.25	3.83	4.50	5.12
55	1.30	1.92	2.56	3.17	3.79	4.41	5.02
60	1.25	1.86	2.48	3.09	3.70	4.31	4.91
65	1.19	1.79	2.40	3.00	3.60	4.20	4.80
70	1.11	1.71	2.31	2.91	3.50	4.10	4.69
71	1.10	1.70	2.30	2.90	3.49	4.08	4.66
72	1.09	1.69	2.29	2.88	3.47	4.05	4.64
73	1.08	1.67	2.27	2.86	3.45	4.03	4.62
74	1.06	1.65	2.24	2.84	3.43	4.01	4.60
75	1.04	1.63	2.23	2.82	3.41	3.99	4.57
76	1.02	1.61	2.21	2.80	3.39	3.97	4.55
77	1.01	1.60	2.20	2.78	3.37	3.95	4.52
78	0.99	1.58	2.18	2.76	3.35	3.93	4.50
79	0.97	1.56	2.16	2.74	3.33	3.90	4.48
80	0.96	1.54	2.14	2.73	3.31	3.88	4.45
81	0.93	1.52	2.12	2.71	3.29	3.86	4.43
82	0.91	1.50	2.10	2.69	3.27	3.84	4.40
83	0.89	1.48	2.09	2.67	3.25	3.81	4.38
84	0.87	1.46	2.07	2.65	3.23	3.79	4.36
85	0.85	1.45	2.05	2.63	3.21	3.77	4.33
86	0.83	1.43	2.03	2.61	3.19	3.75	4.31
87	0.81	1.41	2.01	2.59	3.17	3.73	4.29
88	0.79	1.39	1.99	2.57	3.15	3.70	4.26
89	0.77	1.37	1.97	2.55	3.12	3.68	4.24
90	0.75	1.35	1.95	2.52	3.10	3.66	4.21
91	0.72	1.32	1.92	2.50	3.09	3.64	4.19
92	0.70	1.30	1.90	2.48	3.07	3.61	4.16
93	0.67	1.27	1.88	2.46	3.04	3.58	4.13
94	0.65	1.25	1.86	2.44	3.02	3.56	4.11
95	0.62	1.23	1.84	2.42	3.00	3.54	4.09
96	0.60	1.20	1.81	2.39	2.98	3.52	4.07
97	0.57	1.18	1.79	2.37	2.96	3.49	4.03
98	0.54	1.15	1.76	2.34	2.93	3.46	4.00
99	0.51	1.12	1.74	2.32	2.91	3.44	3.98
100	0.49	1.10	1.72	2.30	2.89	3.41	3.96
101	0.46	1.08	1.70	2.28	2.86	3.39	3.93
102	0.43	1.05	1.67	2.26	2.84	3.37	3.90
103	0.40	1.02	1.65	2.23	2.81	3.34	3.87
104	0.37	0.99	1.62	2.20	2.77	3.32	3.85
105	0.34	0.96	1.60	2.18	2.74	3.29	3.82
106	0.31	0.94	1.57	2.15	2.71	3.27	3.80
107	0.28	0.91	1.54	2.12	2.69	3.24	3.77
108	0.24	0.88	1.52	2.10	2.67	3.21	3.74
109	0.21	0.85	1.49	2.08	2.65	3.19	3.71
110	0.18	0.82	1.46	2.05	2.52	3.17	3.67
115	0.14	0.67	1.31	1.92	2.38	3.02	3.58
120	0.00	0.49	1.16	1.77	2.24	2.90	3.44
125	....	0.30	0.99	1.60	2.07	2.78	3.29
130	....	0.08	0.80	1.43	1.90	2.60	3.14
135	....	0.00	0.60	1.25	1.71	2.42	2.96
140	....	....	0.39	1.07	1.52	2.24	2.78
145	....	....	0.13	0.82	1.42	2.06	2.60
150	....	....	0.00	0.62	1.25	1.86	2.40
175	....	....	....	0.00	0.15	0.75	1.00
195	....	....	....	....	0.00	0.00	0.05
212	....	....	....	....	....	....	0.00

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no question but that all plants are treating ties improperly with zinc chloride, but it is not my understanding that those premises are correct. At our plant, for instance, the treatment of ties with zinc chloride is all done under Dr. von Schrenk's direction, or under the direction of Mr. Bacon, of the Northwestern Road, Mr. Angier, of the Baltimore and Ohio Railroad, or a similar officer of roads for which we are treating ties; and I think it would be well to have some statement from one of these gentlemen as to the actual practice that is in use, because these statements that Mr. Goltra has made certainly do not reflect the actual method of treatment at our plant, and I do not think they reflect the method of treatment at other plants.

THE PRESIDENT: Is Dr. von Schrenk in the room? He does not answer, and I will ask someone to find him. Mr. Card, have you anything to say on this paper?

MR. J. B. CARD: I do not see how it would be possible to treat all species of wood with 3.5% solution chloride of zinc on oak and pine; you might possibly get 0.5 lb. into oak, but you probably would get twice that into your pine. Now, in treating ties we figure on an average absorption. It is absolutely impossible to figure that any one tie will take a half a pound of zinc to the cubic foot. Some ties will take a quarter and some an eighth, and some may take three-fourths. We figure an average charge of 0.5 lb. per cubic foot. The reason we figure 0.5 lb. per cubic foot is because we know from experience that much chloride is required to resist decay, especially in this section of the country. You should figure on the strength of your solution also in connection with the amount of zinc to the cubic foot. I think, in fact, it would be a good thing if the maximum strength of the solution were specified. It would simply mean that if a railroad wanted ties with 0.5 lb. of zinc to the cubic foot, and they insisted that the strength of the solution be not over 4% strong, you would have to dry your ties to a point where you could inject 0.5 lb. per cubic foot with a 4% solution, which would be all the better. The way it works out where you specify 0.5 lb. per cubic foot and no special strength of solution is if you cannot inject this amount with a 4% solution the strength of the solution is simply raised up to 5% and 0.5 lb. is injected.

MR. F. D. MATTOS: Mr. President, I do not think it is so much the location as it is the density of the timber, the class of material as to its ability to absorb the preservative.

MR. WILLIAM A. CECIL: Mr. President, I think that Mr. Goltra is right in his idea—well, now, then, in a way. I will not agree with him on all the points. I will not agree with him on the recommendation to treat all classes of timber, regardless of density, with the same solution. I believe that there should be one solution prob-

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ably for each species of timber; at any rate, timber of a like degree of density should have a solution of a certain strength, but I think if the specifications covered the strength of solution rather than the weight of the dry zinc chloride that was injected into the timber, that zinc chloride would prove to be a more satisfactory preservative than it has heretofore been considered. Mr. Joseph P. Card, our member's honored father, in the "Scientific American Supplement" No. 607, said that "One part of zinc chloride in two hundred parts of water" was about the minimum strength at which zinc chloride may be expected to preserve wood. If 0.5% solution may be expected to preserve wood, then a certain specified weight of dry zinc remaining in the timber after treating is of no consequence. Now, as for methods of determining the true strength of solutions, I have used different methods at different times. I have used the hydrometer. I have used silver nitrate solutions. I have taken the time and determined the zinc chloride in zinc chloride solutions by recovering the zinc as zinc oxide. I have tried to adopt the standard method of zinc chloride analysis recommended by a committee of this Association, I think in 1912, to the purpose, but the hydrometer has proved the most satisfactory of all. For 10 years I have used a table of hydrometer readings corrected for temperature like the table given in this paper, and to meet the requirements of mixtures of zinc chloride and creosote where the solution is made up to strength before mixing with the creosote I extended my table to 5% about two years ago. Five per cent solutions are used with methods of "emulsionizing" mixtures of preservatives. Therefore, a table that stops at 4% is not complete, and I would suggest that Mr. Goltra bring his table up to 5% before publication in our Annual Proceedings. So far as I know, my table is the only one that has ever been worked out for the hydrometer readings between 4% and 5% for all the temperatures given in this table. I will be glad to hand it to Mr. Goltra for consideration, revision if he thinks necessary, or as an addition to his table.

MR. AUGUST MEYER: It is an old saying that what is worth doing is worth doing well, and if we do not treat timber with the proper strength of solution we are not doing good work. By that I mean if you have a strength of solution sufficient to give the required amount of zinc chloride per cubic foot, and the ties are treated to refusal, that is all that is necessary, but you must treat the ties to refusal, and it seems to me that the strength of the solution must be governed by the absorption of each individual kind of wood. We sometimes find that in order to get the proper absorption and penetration, it is necessary to hold the pressure on a charge of wood six hours, whereas at other times we only require five hours or four hours, sometimes only three hours, depending on the kind of wood we treat and the amount of seasoning it has, and for this reason the time of treatment or the

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time of pressure and the strength of solution must be governed by the absorptive power of the wood, and no fixed rules or fixed strength of solution can be applied if you want to do good work.

THE PRESIDENT: Anyone else?

MR. GEO. M. HUNT: Mr. Chairman, it seems to me it would be much more scientific instead of using the Baume hydrometer to use the ordinary hydrometer, which, I think, is in more extensive use for this purpose than the Baume. The fact that the Baume scale is based upon an arbitrary basis, while the ordinary hydrometer gives you a reading which is based on the fundamental relation between the weight of the solution and the weight of the water of which it is composed, seems to me to be a scientific reason why we should use the ordinary hydrometer. There are curves and tables already in existence for the use of the ordinary hydrometer, and I very much prefer to see that made the standard than to see the Baume hydrometer made the standard.

THE PRESIDENT: Mr. Trumbull, do you want to say anything on this subject?

MR. M. K. TRUMBULL: I believe not.

THE PRESIDENT: Is there anyone else?

MR. W. L. R. HAINES: I am only a visitor, and perhaps I ought not to speak.

THE PRESIDENT: I am very glad to give you the floor.

MR. W. L. R. HAINES: I call your attention to some eccentricities of absorption I have noticed in an examination of a number of ties. I had a laboratory analysis made of quite a large number of zinc chloride treated red oak ties to determine the absorption, and I found that while the average as determined by the charge readings was 0.5 lb. of the dry salt per cubic foot, individual ties varied from as low as .03 lb. to as high as 1.28 lbs. per cubic foot. I also found that some ties which were apparently drier than others, due to longer seasoning, had a smaller percentage of dry salt per cubic foot.

THE PRESIDENT: Has anyone else anything to say? If not, we will pass to the report of Committee No. 8, Advertising.

REPORT OF COMMITTEE ON ADVERTISING.

SECRETARY ANGIER: I have nothing much to report. Mr. Beal and Mr. Townsley and myself are on that Committee. Mr. Beal and Mr. Townsley are not present. The advertising that we have re-

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ceived to date for insertion in the 1916 Proceedings amounts to $737.30. The firms who advertised last year, and who have not yet given us a contract, but will probably do so, will increase this amount about $150, making a total of about $900 that we can count on. We will solicit from firms that we did not solicit from last year or the year before, and may get some from them. We still have three months in which to do this work, as the Proceedings will not go to press until about the first of April. With a little extra effort on our part we may be able to get as much as we did last year, which was about $1,100. I think it is very essential to get this to carry on the work of the Association, and it behooves us all to do what we can to get advertising. The Committee will appreciate any help they can get from any member of the Association in the way of suggestions as to who might advertise, or to actually get an advertisement for us.

THE PRESIDENT: Committee No. 9 has asked for more time. They want to bring in their report tomorrow. Committee No. 10, Statistics, Mr. E. T. Howson, Chairman.

REPORT OF COMMITTEE ON STATISTICS.

MR. E. T. HOWSON: Mr. President, I do not know just what report the Committee on Statistics can make. When the Committee was appointed it was told that its report would consist of the preparation of the statistics for the Proceedings, and that no report would be expected at the convention. Consequently, our report is not due for three months yet. The Committee, working with the Secretary, has been in communication with the Forest Service at Washington, which department has collected and compiled the statistical information in previous years. The Forest Service is going to continue this work for us this year, and, in fact, is now continuing it, and is expanding it somewhat, taking up some features which have not been covered previously.

SECRETARY ANGIER: In connection with this report Mr. Cherrington, I think, made a very good suggestion, in that this Committee, or the Secretary, get up an index covering all back volumes and bringing it up to date. As I understand, it was to be printed in the 1916 Proceedings. We can work this up if it is the wish of the Association that it be done, and incorporate all the Proceedings in one index and publish it in the 1916 Proceedings.

THE PRESIDENT: What is your pleasure on that, gentlemen? We will leave that to the incoming Executive Committee.

MANUAL OF RECOMMENDED PRACTICE.

THE PRESIDENT: I do not know of anything more we can bring up before the convention today unless my friend, Trumbull, would

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like to talk about a Manual. Would you like to talk about a Manual a few minutes? I would be glad to have you?

MR. M. K. TRUMBULL: I was much embarrassed that my name was mentioned in the President's Address this morning, when he spoke of the proposed Manual. I am willing to do everything I can to help when I am called upon. I have little to say now. In my opinion, there is a distinct demand for a Manual, just as there is in the American Railway Engineering Association. That demand is not on our part so much as it is by the users of creosoted material. We have in our company frequent requests for information, to which we must respond by letter. If we had a Manual to which to refer, their questions would be answered more readily and with more authority than if we individually offer our views. We are virtually forced to the latter procedure at present. In this connection I might state that I have talked with the chief engineer of one of the large railroads of the West yesterday. He thinks the American Railway Engineering Association should take the deliberations and conclusions of this Association rather than to have their own Committee on Wood Preservation. The activities of the Signal Association are so adopted by the A. R. E. A. A Manual on Wood Preservation published by our Association and endorsed by the American Railway Engineering Association would be of incalculable benefit to the industry.

THE PRESIDENT: I might state an experience I had. Last year after these Proceedings were issued an officer of our road called me in and said: "I have not time to read this through. I wish you would tell me where I will find what I want." Now, if we had a Manual, as I understand my friend Trumbull, I could have said: "Right here it is, boiled down."

MR. M. K. TRUMBULL: That is the point exactly. You called on me rather suddenly. I did not have in mind the things I really wanted to say. That is one of them. We have so many calls for information. Authority is wanted other than the statements of individuals. The only thing we can do now is to submit copies of our Proceedings. Our questioners find themselves in the same position that your official was in. They do not want to wade through a great lot of matter and possibly not get what they are looking for. If pertinent matter were all condensed in the form of a Manual; if all the information that pertained to standard practice were selected from our Proceedings, and this matter supplemented by the work of a committee to edit it in orderly manner, it would be of value. I do not believe that an acceptable Manual can be prepared in the course of a single year, for the simple reason that whatever is done by a committee should be submitted to the Association by letter ballot. The criticisms of the members should be invited and urged, so that they can study the propo-

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sition carefully. The members' suggestions and criticisms should then be tabulated and analyzed. The Committee on Manual would thereby have something to offer at the next Convention. The resolution which was prepared a year ago had that in view. A start should be made with the view of preparing a Manual with no time set as to when it would be published.

MR. S. R. CHURCH: Mr. President, I believe that there is certain material in the Proceedings of the Association at the present time which, under the resolution adopted at the last meeting, is already available for the Manual. It is not necessary, as I see it, that the Manual should be published as a complete work setting forth the principles of wood preservation in their entirety, but that when any committee has presented a report embodying certain definite standards or principles which have been accepted or approved by the Association, this can be printed in large type and indexed as being a part of the Manual. Then, when it becomes advisable, owing to the amount of such matter, to print it separately, or to reprint all that matter in your Proceedings, at such time that can be done. At the present time the Proceedings for several years back should be gone through, and such portions as have been adopted by the Association should be referred to in the index as being a part of the Manual. I think a part at least of what Mr. Trumbull is aiming at could be accomplished.

MR. E. T. HOWSON: Mr. President, I would like to support what Mr. Trumbull just said about the Manual. The American Railway Engineering Association has been the greatest factor in the maintenance of way department in standardizing maintenance of way practices. This has come about largely through its Manual. It would seem to me that a Manual of this Association would be a big aid in standardizing practices in this field. From another standpoint a Manual would be of even greater importance. New men are coming into the field, particularly as users of timber. There is no one single volume today that I know of to which a man can refer to get the latest information on timber preservation. You might say that one could refer him to the Proceedings of the American Wood-Preservers' Association, but the particular subject he might want might be in any one of the 12 volumes. A man is not going to purchase, even though they were in print, those 12 volumes; but if there was in existence a Manual containing the recommended practice of this Association which it recommends, this would be available for him in such form that he could keep it on his desk. Many of the users of treated timber are not members of this Association. They are using treated timber in conjunction with many other materials, and they want information concerning it. Such a Manual would give the information in a condensed way that I believe would be of great value to the man himself and to this Association.

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MR. J. C. WILLIAMS: Taking what Mr. Trumbull has said and what Mr. Church has said, and sort of pasting them together, gives me a foundation for a suggestion. My idea is to get Mr. Angier's index prepared this year, and have it bound separately, instead of being put into the Proceedings. Do not call it a Manual. We are not ready for a Manual yet, I believe, but an index, and in that index whatever titles there are of reports or papers that this convention or other conventions have accepted as standard practice, and have given the stamp of approval of the Association, can be indicated either by special faced type or by the words "Recommended Practice of the Wood-Preservers' Association" in parenthesis that will give us a sort of temporary expedient, and carry us along until such time as Mr. Trumbull's committee on the Manual can get out something more definite. It will help those people who do not want to wade through the Proceedings to locate certain articles, and I think it will be handier if it is bound separately than to have it bound in the Proceedings.

MR. M. K. TRUMBULL: Mr. President, for the benefit of the last speaker, I might state that there is no such committee (laughter).

THE PRESIDENT: We hope there will be.

MR. M. K. TRUMBULL: It is just being discussed. The suggestion is excellent, but does not carry through to conclusion. For instance, I had a chief engineer ask me to show him what was standard practice in the treatment of red oak ties. I carried five volumes of the Proceedings of the American Wood-Preservers' Association to his office. What I had to show him was disconnected. Some of the matter was sifted out of the discussion on some other topic. In other words, there was not any consecutive line of thought to offer, nor any specifications to be recommended. Secondly, I have had similar requests for information when the creosote shortage developed as to the treatment with zinc chloride. The same thing happened again. I am probably not the only one. Nearly every man in the Association has been called upon to produce the consensus of the opinion of this Association on standard practice. By having a Manual, no matter if it consists of loose-leaf printed sheets, which may not take in the first place more than 30 or 40 pages, because we have not a great deal of matter now that is adaptable we can present it to whoever seeks information. The latter does not have to rely upon the opinion of Mr. Jones or Mr. Smith, who may be discussing an order with the prospective customer. He does not have to take one man's opinion or two men's opinions as to what should be adopted. He secures the Manual, which is the consensus of opinion of the American Wood-Preservers' Association, as to what is standard practice in this particular line on which he wants information.

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MR. C. W. LANE: Mr. President, consider the status of the younger men in this profession. If the young men are operating a certain plant that is using a certain process, and they wish to know suddenly something relative to another process, they have not the benefit of the experience of older men, and they are compelled to search through a great amount of matter to get the information they are looking for, and possibly will be unable to find. If this convention means anything at all it is certainly a campaign of education, and speaking for several of my friends as well as for myself, and desiring further light I earnestly hope that the convention will definitely at this meeting take steps toward the formation of a Manual which will govern standard practice in all processes.

THE PRESIDENT: Anything further? Now, tomorrow we will have a full day. We would like to get everything done except the business here tomorrow. Of course, if we do not we will carry it over. We would like to have the business session Thursday morning and not adjourn until we are through, providing that is the wish of the members of this convention.

Mr. Joyce, Chairman of the Entertainment Committee, then made an announcement concerning the annual banquet and the entertainment provided for the ladies.

THE PRESIDENT: If there is nothing more we will stand adjourned till 10 o'clock tomorrow morning.

An adjournment was then taken till 10 o'clock A. M., January 19.

WEDNESDAY MORNING SESSION.

January 19.

The meeting was called to order at 10 o'clock A. M., by President Waterman.

THE PRESIDENT: Mr. Angier has received two or three messages he wants to read.

Secretary Angier then read telegrams from F. D. Fenn and F. D. Beal, as below:

NEW YORK, JAN. 18, 1916.

J. H. Waterman,
Pres. Am. Wood-Preservers' Ass'n.
Chicago.

I regret to advise that I am detained here until tomorrow night. Therefore, cannot be with you during this convention. My kindest regards to you all, and best wishes that this will be the best convention you ever had.

F. D. Fenn.

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SAN FRANCISCO, CAL., JAN. 18, 1916.

F. J. Angier,
Sec., Am. Wood-Preservers' Ass'n.,
Chicago.

Regret my inability to be with you. Give my kindest regards to all members. With wishes for successful meeting,

F. D. Beal.

THE PRESIDENT: Now, Dr. von Schrenk has some very fine specimens on this table. He says he will be glad to have everybody look at them, but we American people like to handle things. He will be very much pleased if you will just look at them and hold your hands behind your back, because they are valuable specimens, and while they may look as though you could not destroy them, you can.

Now, the first order of business will be the report of Standing Committee No. 1. (Preservatives) Mr. Fulks.

REPORT OF COMMITTEE ON PRESERVATIVES.

MR. E. B. FULKS: Mr. President, Mr. Drefahl, the Chairman of the Committee, is not here and all I know about the activities of the Committee is that I had a letter from him a few days ago in response to a request for information saying that the Committee has had no meetings during the year, that he had been so busy with affairs of his own he simply had not had time to give it attention. But aside from that along sometime in the summer he appointed me a committee of one, that is, representing the Committee on Preservatives of this Association as a member of a joint committee consisting of Dr. von Schrenk, representing the American Railway Engineering Association, and Mr. Church, representing the American Society for Testing Materials, to work out some method for sampling tank cars for determining the amount of water in oil. This Committee had several meetings during the past few months and did quite a good deal of work on it, collecting the various sorts of devices now in use and all that sort of thing, made a lot of tests, and finally, just before Christmas, made some actual tests by loading some cars with dry oil, putting in a measured amount of water and sampling and doing a lot of stunts at place of loading and then shipping them to a plant and then doing this sampling all over again. This work was done just before Christmas and just after New Year's. The work of the tests really was in charge of a sub-committee of the American Railway Engineering Association, with Mr. Church and I as members of this joint committee working with them, but the data are in the possession of this sub-committee of the American Railway Engineering Association and are not worked up to the point where same can be presented. I understand there was a meeting of this committee of the American Railway Engineering Association last night, at which

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a preliminary report was presented by Dr. von Schrenk similar to what I am doing now verbally and advising them this would be ready. Of course, their report is not due for several weeks yet, and I think I am safe in saying that this will be ready for publication and that I can turn it in to our Secretary before the Proceedings of this meeting go to press so that it can be published in that, and with it there will be a tentative recommendation of a method but not one for final adoption. We disposed of a lot of methods of sampling just by elimination. They would not work at all, but there were one or two schemes that gave evidence of working fairly satisfactorily. Now, we propose to ask that this be continued and we be given further time to pursue this line of work and to make these tests again during the summer time on a more extensive scale and be ready for final report, we hope, next year. I understand this is the same action that was taken in the report of the American Railway Engineering Association's committee last night.

THE PRESIDENT: Are there any other members of that committee here, and have they anything to say, or has anyone else anything to say on the subject?

DR. H. von SCHRENK: Mr. President, I just want to rise to make an explanation and to express my personal gratification that there was one case where three great national bodies got together, the American Society for Testing Materials, the American Railway Engineering Association and the American Wood-Preservers' Association, all trying to do the same thing, and instead of each one trying to do it by itself, working out its own problems, the bodies got together and are working this thing out harmoniously so that it will be a joint report. I think it is a pretty good occasion for congratulation.

THE PRESIDENT: Has anyone else anything to say?

Now, we will have the pleasure of listening to an address or talk by Dr. Shackell. He will tell you what his subject is. He comes before us by personal request to make this address.

MARINE BORERS FROM THE WOOD-PRESERVERS' STANDPOINT.

By Dr. L. F. Shackell.

Last year I read a paper before your Association on the effect of creosote and certain of its fractionates upon the most destructive of the marine borers, Xylotrya. That paper was of such a technical pharmacologic nature that it was not well suited to the wants of practical wood-preservers. The talk I desire to give this morning, on the other hand, is to consider the general subject of marine borers, particularly from its economic standpoint.

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My paper will be divided into three general phases: First, a resume of the experimental and practical treating results to date; second, as logical an interpretation as possible of these results; and third, the formulation of the desiderata for the successful treatment of piling to resist the attacks of marine borers. I really hope that my remarks will prove of more practical value to wood-preservers than were the efforts of one man who admitted that his sole contribution to the conservation of timber was the fact that he used the same toothpicks twice.

First, as to the conclusions reach by practical treating men: Many of the latter claim that certain specific constituents of creosote must be present in sufficient quantities in order that good results may be obtained. One man says that a high proportion of naphthalene is necessary, another that the tar acids are the essential things, and so on. These conclusions are in the main based on observations of treated timbers which have stood up for many years. But these same timbers were treated with creosote oil at a time when methods of analysis were not at all complete. Conclusions of this sort, based on general observations, do not take into account the large number of factors involved and are of little value.

Other more specific observations along this line consisted in the analysis of oils extracted from timbers which had stood up well. Professor Alleman was perhaps one of the first men who carried out careful experiments of this sort. Mr. F. B. Ridgway before this Association two years ago read a paper along this same line. It is difficult to draw conclusions from these two investigations, taken by themselves; but in connection with subsequent work which we have done I think that their data become very valuable.

Still another line of work consisted of a series of service tests carried out by the Forest Products Laboratory. The tests were made with small experimental pilings which had been treated with a good grade of commercial creosote. Other specimens were treated with fractionates of this same creosote as follows: Fraction I was the creosote distillate up to 205° C.; Fraction II from 205° to 250°; Fraction III from 250° to 295°; Fraction IV from 295° to 320°; while Fraction V was the residue above 320°.

The following were the general results of the service tests: The treatments with Fractions I and II, the low-boiling oils, containing large quantities of light oils, tar acids and naphthalene, went out first; in fact, did not seem to stand up against the marine borers at all. On the other hand the specimens treated with Fractions IV and V, high-boiling preparations, have not been destroyed in four years, though they are gradually being attacked. The fractions containing high-boiling residues at any rate protect piling the best, as shown by actual service tests.

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Now, about a year and a half ago arrangements were made for cooperative investigations of marine borers between the United States Bureau of Fisheries and the Forest Service; and my part of the work, under the auspices of the Bureau of Fisheries was to carry out experiments involving direct observations of the toxic effects produced in the borers by these creosoting materials, especially the individual constituents of creosote. As I have said, the first investigations along this line were reported to this Association last year.

During the past summer two lines of investigation were pursued: one a continuation of the toxicity work, using Limnoria instead of Xylotrya; the other a series of modified service tests of treated wood, which was sheathed with untreated wood to serve as bait for the borers.

In the work with Limnoria the same general experimental methods were used in the work with Xylotrya. Since it was possible to establish, however, much more definite criteria of toxicity in the case of the Limnoria, the relative toxicities of the different creosote preparations could be determined with considerable accuracy. Nevertheless the results obtained with Limnoria definitely confirm those obtained with Xylotrya. Further, to anticipate any query as to the number of borers that I worked with, I may say that my conclusions with respect to Limnoria are based on detailed observations of nearly 7,000 individual specimens.

As I have said, the general results of both series of toxicity experiments were the same, that is Fraction I, the lowest-boiling distillate, was the most toxic; while Fraction V, the highest-boiling, was the least toxic. The creosote and its distillates, arranged in the order of their diminishing toxicity are: Fraction I, Fraction II, Creosote, Fraction III, Fraction IV, FractionV. These results are futher interesting from the fact that they are diametrically the opposite of those obtained in the service tests. That both sets of results can be reconciled, however, I shall attempt to show later.

Experiments with individual constituents of creosote gave very interesting results. Of the light oils benzol, toluol and a mixture of the isomeric xylols were tested; of the tar acids phenol, cresol (tricresol) and alphanaphthol; and of crystalline hydrocarbons naphthalene, acenaphthene, phenanthrene and anthracene. In general, the light oils as well as the tar acids are highly toxic for marine borers; whereas the crystalline hydrocarbons in comparison are but slightly toxic. Of the light oils benzol is the most and the xylols the least toxic, Of the tar acids alphanaphthol is by far the most toxic, while carbolic acid is the least toxic. For instance, alphanaphthol in a strength of 0.1% will kill the majority of Limnoria in about 40 minutes; whereas phenol in the same strength will not kill the same proportion in seven hours. As for the crystalline hydrocarbons, though naphtha-

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lene will kill Limnoria in 12 to 18 hours, the other hydrocarbons take from two to five days.

The second line of work carried on during the past summer consisted of service tests of wood which was sheathed after treatment. It occurred to me that results which might elucidate the opposing data of the service tests and the toxicity work might be obtained by treating specimen pilings, covering them completely with untreated sheathing and installing them for several months in waters infested with Xylotrya. The idea was to have the sheathing serve as bait and then as shelter for the borers until they should reach a size sufficient to render them easily observable, and then see what happened to them when they reached the treated cores. The Forest Products Laboratory very kindly offered to carry out the treatments, which were made last May.

The wood which was treated consisted of sticks of sap loblolly pine, for the most part 3"x3"x36," and finished on all sides. After treatment with creosote, with the various fractions and with a few special preparations the sticks were sheathed on sides and ends with untreated ½ in. pine boards. The specimens were then shipped to Beaufort, on the North Carolina coast, where I had carried on the toxicity experiments at the Bureau of Fisheries Biological Station. The sticks were installed in the sea-water of Beaufort Harbor at the height of the breeding season of Xylotrya, and allowed to remain for six months. At the end of that time, about the middle of December, they were sent back to Madison and carefully inspected. The results were really very striking.

The sheathing was riddled in the majority of the specimens by Xylotrya and Teredo. Further, in every case the treated core was attacked to a greater or less extent; whereas the unsheathed controls treated with creosote and with the five fractions were with but a single minor exception absolutely free from signs of attack. These results are all the more striking when one considers that the unsheathed controls had every opportunity to lose toxic substances by volatilization in the period between treatment and installation. Furthermore, they probably had a greater opportunity to loss toxic substances through leaching out into the sea-water than did the sheathed specimens.

To recapitulate my talk thus far, I have considered briefly the opinions of practical wood-preservers as well as experimental work concerned with the problem of marine borers, including analyses of oils extracted from well-preserved pilings, service tests of creosote and its distillates, direct toxicity determinations of these same preparations on the two main types of borers, and finally the work with the sheathed treatments. All of these require a logical interpretation to be of

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any value. Since the results on the sheathed specimens seem to me to be very important, I shall take them up first.

What is the explanation for the fact that Xylotrya will pass directly from an untreated sheath into a heavily treated core, while it will not attack at all, at least within six months after installation, treated sticks which have been left unsheathed? The reason is this: Xylotrya enters a piece of wood in every instance as a very minute organism just visible to the naked eye. But once it has obtained a foothold in the wood Xylotrya undergoes a metamorphosis, and grows with such rapidity that in two or three weeks it attains a size thousands of times greater than when it first enters the wood. The result is that an embryonic Xylotrya, which would be readily killed by contact with well-treated wood, is enabled to grow to a relatively great size in the sheathing, and then, when it reaches the treated portion, can withstand high concentrations of toxic substances in the wood. Xylotrya is further aided in this respect by the fact that it lines its burrow with a shell which is impervious to water and creosote oils; so that the only part of the borer's body which comes in contact with treated wood is a small portion adjacent to the boring shells.

The analogy between conditions which actually exist in many treated pilings and the artificial conditions of the sheathing experiments is after all a very close one. It is recognized by treating men that it is exceptional to secure uniform penetration throughout a pile; and, furthermore, that it is a physical impossibility to inject a sufficient amount of creosote into knots, resin streaks and pitch pockets. Yet the portions of a pile which have received only a very light treatment, and from which toxic substances readily leach out, are the very places in which the minute Xylotrya secures a foothold. Once into the wood the borer rapidly reaches such a size that it can burrow with impunity through the heavily creosoted portions of the piling. These sheathing experiments, then, serve to clear up many apparently inexplicable failures of carefully creosoted piling.

I have said that toxicity experiments with creosote and its fractionates gave results the opposite of those obtained in service tests; that is, treatments with the low-boiling fractions, which were by far the most toxic, did not prevent attacks, while the high-boiling fractions, which I found to be the least toxic, withstood attacks very well. How can these results be reconciled? It seems to me that this can best be done by referring to the relative quantities of high-boiling constituents in the creosote and the several fractions; for the belief has been expressed by several investigators that large quantities of high-boiling constituents are essential to obtain the best results in service. In this connection the data on the fractions are as follows: Fraction I had a residue above 225° C. of only 8%. Fraction II had a residue above 287° of

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but 4%. Fraction III had a residue above 320° of 14%. Fraction IV had a residue above 320° of 45%; while Fraction V had a residue above 320° of 85%. You will recall that Fractions I and 11, which, as we have just seen, distil practically completely below 300°, are highly toxic, and yet do not possess good staying qualities in wood; whereas Fractions IV and V, very high proportions of which boil above 320°, combine low toxicities with good staying qualities.

Now, a number of the specimens of last summer were allowed to season for two weeks between the time they were treated and the time that they were sheathed. I happened to note that there was a striking difference in the proportion of the material injected which was lost by seasoning in light as against heavy treatments. For instance, with 5.4-lb. treatments with Fraction I the losses in two weeks in two cases were, respectively, 29.6% and 28.1% of the amounts injected; whereas with 14 and 13-lb. treatments, respectively, the losses in two weeks were only 19% and 16%. In other words, it would appear that the lighter the treatment the greater is the volatilization; the heavier the treatment the less the loss during seasoning—not in absolute pounds, but in percentage of the quantity of creosote injected into the wood. If this generalization will hold for commercial work, it is of the greatest practical significance. I have further data to support this hypothesis.

In connection with the service tests of creosote and its fractionates, carried out by the Forest Products Laboratory, Mr. C. H. Teesdale published a paper on the volatilization of creosote after injection into wood; and expressed the opinion, based on a study of the losses during seasoning, that high-boiling constituents probably tend to hold toxic materials in the wood. The volatilization data on individual sticks in two series—one, heavy treatments of loblolly pine, and the other light treatments of longleaf pine—are highly interesting. I shall cite only a few of these data; though I may say that throughout both series, comparing only loblolly with loblolly and longleaf with longleaf, this inverse relationship of volatilization to the weight of the oil injected is so constant that it can scarcely be a coincidence. Take a few typical examples from the treatments of longleaf pine: A 6.6-lb. treatment with Fraction I lost 60% during a seasoning of three months; a 13-lb. treatment lost 51% in the same time. The difference between the percentage losses here is not very striking; but is explained by the fact, previously mentioned, that this fraction had a residue above 225° C. of only 8%—a proportion evidently insufficient, even with the heaviest treatments, to retain volatile substances in the wood. On the other hand, a 5.1-lb. treatment with the creosote lost 44% in the three months' seasoning; whereas a 14-lb. treatment lost but 18% in the same time. Again, a 3.6-lb. treatment with Fraction V, which was practically a soft pitch, lost 29%, whereas a 15-lb treatment lost but 6% in the three months.

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Of course, the high losses with light treatments may be due, in part, to evaporation of water; but I am inclined to think that this factor is negligible. The significance of these data on losses during seasoning of treated specimens is probably this: In order to limit as far as possible the loss of low-boiling, toxic substances by volatilization before pilings are installed and by leaching after they are in the water, one must inject oil in such a quantity that the loss becomes a direct percentage function of the amount injected. From the few data available this point seems to be reached with 18 to 20 lbs. of an average creosote oil per cubic foot.

It seems to me very important to consider losses during seasoning from the standpoint of percentages rather than of absolute pounds; for, though the loss in pounds in a given time is a function of the surface exposed, and is practically independent of the quantity of oil injected, the essential point is that the proportion of the original quantity injected which remains in the wood after seasoning is going to be the determining factor in the protection that the treatment affords against marine borers. Again, since the volatile constituents of creosote lost during seasoning are, as I have said, highly toxic for the borers, any method by which these constituents may be retained in the timbers would seem to make for greater effectiveness; and this would apparently be best secured in practice by heavy treatments with oils containing large proportions of high-boiling constituents.

I have mentioned the analysis by Professor Alleman and by Mr. Ridgway of oils extracted from well preserved pilings. One of the facts most consistent throughout these analyses is that the oils contained large quantities of high-boiling constituents—40 to 55% in many cases boiling above 320°. Furthermore, Mr. Ridgway, who made numerous determinations of the tar acids in his extracted oils, found them to range usually from 10% to 12%. It is significant that in my toxicity experiments the tar acids were found to be the most poisonous of any of the substances investigated.

To conclude, I desire to formulate briefly from my viewpoint the desiderata for effective protection of pilings from marine borers. In the first place, the piles to be treated should be of the highest grade obtainable; for, assuredly, the best are far from being too good when one considers that, in actual practice, it is impossible to obtain any proportion of piles free from such serious or even fatal defects as knots, resin streaks and so on. Again, the peeling and seasoning of piles preparatory to treatment should be very carefully done. As to the type of creosote to be used, there are, it seems to me, at least two essential requirements: First, the proportion of the oil boiling above 320° C. should run not less than 25%, preferably above 40%; and, second, the oil should contain not less than 10% of tar acids. The quantity of oil to be injected should be at least 18 lbs. per cubic foot,

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preferably to the point of refusal. As for naphthalene, I believe it possesses very little efficiency, at least by itself. Statements to the contrary by treating men have been based uniformly on empiric observations; and are not supported by carefully controlled experiments. Suffice it that pure naphthalene is only slightly toxic for Xylotrya. Further, Fraction II, which was solid with naphthalene, did not show up at all well in service tests. The inspection of the treated pilings should never be perfunctory. It seems to me that more adequate methods of inspection are needed, and could be devised with a little further study. Finally, the greatest care should be exercised during installation to prevent exposure of untreated wood below the high-water line; for the sheathing experiments show how fatuous is the belief that any ordinary treatment will withstand the attack of Xylotrya once it secures the least foothold.

The protection afforded against marine borers by coal-tar creosote, though the most effective at present, considering its cost, is far from being as uniform as some enthusiasts would have us believe. The activities of the borers, even against expensively treated structures, constitute a very important economic problem, the solution of which does not lie in perfunctory treatments with any creosote oils which may happen to be available. But, in the present state of our knowledge, comparatively effective results can be obtained by painstaking, conscientious work on pilings from the time they are selected until they are installed, (applause).

THE PRESIDENT: In behalf of the Association it is hardly necessary for me to say to you, Doctor, that we appreciate this, because the applause indicated that, but we certainly appreciate your coming from St. Louis to address this body of men.

I want to compliment the organization for getting together this morning by ten minutes past ten. I have been to a good many conventions, and I never saw so many in the convention hall so early in the morning (laughter). Another thing I want to mention while I am on my feet is that we want everybody to register. About 140 have registered, but sometimes members drift in the second or third days and forget or neglect to register. Now, we would like to have everybody register that comes in the convention or attends the convention. Now, perhaps I have wandered a little. I wonder if there is anybody that wants to discuss what our friend, the Doctor, has said this morning.

MR. N. C. BROWN: Mr. Chairman, I would like to ask the Doctor what the sheathing consisted of in those experiments carried on in connection with the Forest Products Laboratory on the coast of North Carolina.

DR. L. F. SHACKELL: The sheathing consisted of ½-inch

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boards of loblolly pine, screwed on the ends and sides of treated, squared timbers, 3"x3"x3'. The surfaces of the treated core and the inner surface of the sheathing were finished, so there was direct contact between the sheathing and the treated portion. The sheathing was untreated, and served simply as bait for the borers.

MR. E. B. FULKS: The Doctor presented quite a lot of valuable facts here, and I am sorry that this paper was not presented in printed form just as our others are, because he has said a number of things which I think should be discussed. I do not mean by this that I disagree with him, but he presented them in such a rapid manner I could not make notes, and I have forgotten most of it; but erroneous conclusions may be drawn from several things he said.

For instance, in regard to light and heavy treatments he produces figures to show that the volatilization on light treatment is greater than from a heavier treatment, but neglects to state that the rate of evaporation is a function of the surface area, and in each case the surface was the same. As I remember the figures, his heavy treatment was approximately three times as great as his light, his volatilization approximately one-third. Therefore, the rate of evaporation was the same. There are a number of such things as that in his paper that may lead people who are not familiar with this subject to draw conclusions which are not right, and to draw the conclusion that the present treatment of piling is perhaps entirely wrong. Nevertheless, the fact exists that the Gulf of Mexico is full of piles that have been there 30 or 40 years treated with ordinary creosote. So, I think that in the publication of this paper due consideration must be given to the fact that it has not been subjected to as much criticism as it should be.

THE PRESIDENT: Does anyone else want to ask the Doctor any question or discuss the paper in any way or his address?

MR. W. H. FULWEILER: Mr. Chairman, there was just one point that occurred to me. The Doctor spoke very rapidly, and I may not have gotten the explanation very clearly, but it seemed to me that he referred to Mr. Teesdale's result showing that Fraction V of the coal-tar creosote was very effective, as it contained some very high-boiling oils and almost no tar acids, while Fractions I and II were not effective, and yet contained high tar acids, but when he comes to his recommendation for a preservative, he insists on a very high percentage of tar acids, whereas my recollection was that Fraction V contained a very low percentage of tar acid. I do not see just how he reconciles those two points, why he should insist on the high percentage of material when practical tests had shown that it was the high-boiling and low percentage in tar acids that gave the best results.

DR. L. F. SHACKELL: The reason why a high percentage of

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tar acids seem to me to be necessary is that powerful poisons are needed to prevent generalized attack by borers which may happen to get into a poorly treated portion of the pile. Now, the tar acids in sufficient concentration are powerful local poisons; so it is not unreasonable to assume that if there is a high percentage of tar acids in the oil, borers which may secure a foothold in a small portion will not be able to disturb the stability of the pile by going through the heavily creosoted part; for the boring part of the animal will probably be anesthetized by the tar acids. I feel that this would be not at all impossible under actual commercial conditions.

THE PRESIDENT: Are there any more questions?

DR. H. von SCHRENK: Mr. President, I would like to ask the Doctor whether any experiments were made this year in connection with the similar question which I asked last year, namely, reversing the process and determining the toxicity of certain fractions in a manner different from the one presented last year, namely, instead of using fractions by themselves, the remainder of the oil was used minus the fraction.

DR. L. F. SHACKELL: Nothing of that sort was done. I personally do not feel that results of any great value would be obtained by determinations of the toxicities of residues obtained by taking out certain constituents from creosote or its fractionates. Such residues would have an unknown composition, so that no general conclusions could be drawn from toxicity results obtained with them. On the other hand, I believe that results which are more susceptible of evaluation may be obtained by toxicity experiments with definite purified constituents of creosote.

MR. S. R. CHURCH: Mr. President, tests made by Mr. J. M. Weiss in our laboratory a number of years ago on the toxicity of various creosote oils and constituents of creosote in their action on wood-destroying fungi indicated that the so-called bases or nitrogen compounds of which pyridine is the low-boiling and acridine the high-boiling type, were extremely toxic. I would like to ask Dr. Shackell whether any of his tests or any tests that he contemplates involve the determination of the toxicity of the nitrogen compounds in their effect on marine borers? I can give you samples of the different bases if you desire to use them.

DR. L. F. SHACKELL: Basing my opinion on what is known concerning the pharmacologic actions of the tar bases, I should say that they would be very poisonous for marine borers. If I continue this work next summer, I should be glad to obtain some of the tar bases for a study of their toxicity.

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MR. M. K. TRUMBULL: Mr. President, I did not catch all Dr. Shackell said, but from what I understood of his remarks relative to volatilization, there must have been some period of time in which these different fractions volatilized as stated.

DR. L. F. SHACKELL: The seasoning period was three months for the specimens of longleaf pine, which received a light treatment; and two months for the loblolly pine specimens, which received a heavy treatment. My illustrations were taken from the longleaf series. The diameters of the test pieces were practically the same throughout.

THE PRESIDENT: Are there any other questions or remarks?

MR. J. C. WILLIAMS: Mr. President, I would like to ask the Doctor what the temperature ranges were on the numbered fractions. He numbered his fractions one, two, three, four and five, but I did not grasp just what was the arrangement of those fractions.

DR. L. F. SHACKELL: Fraction I was a distillate of creosote up to 205°; Fraction II from 205° to 250°; Fraction III from 250° to 295°; Fraction IV from 295° to 320°; and Fraction V the residue above 320°.

MR. J. C. WILLIAMS: That brings me to the next point. If I understood him correctly, Fraction II gave him the second best results. Now, the range of temperature from 205° to 250° would include practically all the naphthalene that there would be in an ordinary creosote oil, and then in his conclusions he condemns the naphthalene almost entirely. I would like to have him reconcile that.

DR. L. F. SHACKELL: My poor opinion of naphthalene is based on the following considerations: Pure naphthalene is only slightly toxic for Xylotrya. Again, Fraction II, which was solid with naphthalene, did not stand up in service tests, though, as I have said, Fraction II was very toxic. This toxicity, however, must have been due to other constituents than naphthalene. I do not believe that naphthalene unless held in the wood by high-boiling compounds would be efficient. Even then I doubt whether any quantity of naphthalene would prevent a general attack, once the borers got a start; unless it is true, as some investigators have claimed, that naphthalene would be changed in the bodies of the borers to the very poisonous naphthols.

THE PRESIDENT: Any further question? We will pass the subject unless someone has some other remarks to make. Mr. Winslow promised me that Mr. Sterling would be here at 11 o'clock. It is 11:01. Is Mr. Winslow in the room?

MR. C. P. WINSLOW: Here.

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THE PRESIDENT: Is Mr. Sterling here?

MR. C. P. WINSLOW: Mr. Sterling was to be here about 11 o'clock. I have not seen him yet. He 'phoned me he would be here about 11.

THE PRESIDENT: What is the pleasure of the convention? Do you want to take up the report of Committee No. 2 before he comes, or do you want to wait until he comes?

DR. H. von SCHRENK: He will be here about 11 o'clock, he said.

THE PRESIDENT: It is 11 o'clock now (laughter). If Mr. Church is ready we will take up the report of the Special Committee on Specifications for Preservative for Wood Paving Blocks. Before we take that up I want to make a statement to this convention. Mr. Drefahl is Chairman of that Committee. We labored with him to get him to give us a definite promise that he would do something or prepare specifications for wood paving blocks. We could get no definite reply from him. At last I wrote him personally. I did not write each member of the Committee, but I wrote him and asked him if he had any objection to a special committee being appointed to prepare specifications for wood paving blocks, and he answered me he had no objection. Now, I presume I have offended some members of his Committee, the Committee on Preservatives, but I will take the responsibility, and you can light right on me as hard as you want to. I did the best I knew how, and I felt that if the Chairman of the Committee turned it over, or willingly relinquished it, that I had done all I could do. Therefore, I appointed Mr. Church and the other two members on this Committee. Mr. Teesdale, who has a report to bring before you, said his report would not be complete without a specification. Now, we will hear from Mr. Church.

MR. S. R. CHURCH: Mr. President and members of the Association: The Special Committee, of which I was Chairman, was requested by President Waterman about the latter part of October, I think, to prepare a specification on preservative oil for the treatment of wood paving blocks. This Committee, which consisted of Dr. von Schrenk, Mr. Newton and myself, has presented a written report, and with the exception of the methods of testing and analysis, the report is comparatively short, so that I will read it.

REPORT OF SPECIAL COMMITTEE ON SPECIFICATIONS FOR PRESERVATIVE FOR WOOD PAVING BLOCKS.

To the Members of the American Wood-Preservers' Association:

Your Committee presents herewith the specification that was pre-

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sented to the American Society of Municipal Improvements, at its annual meeting in Dayton, Ohio, in October, 1915, by A. W. Dow, in behalf of said Association's Committee on Standard Specifications for Creosoted Wood Block Paving.

Your Special Committee has been engaged, for sometime, in the consideration of this matter of preservative specifications, and is firmly of the belief that the united action of two or more representative bodies would go a long way towards eliminating the present confusion. Other associations would be likely to endorse the specification, and a positive benefit to the industry would result.

Inasmuch as your Committee can endorse this specification, and it is a representative one, reflecting the judgment of the majority of leading authorities, including producers and consumers, your Committee earnestly recommends its adoption by the Association.

Preservative.

The preservative shall be wholly derived from coal gas tar or coke oven tar, and shall comply with the following requirements:

1. The specific gravity shall be not less than 1.06 nor more than 1.12 at 38° C.

2. Not more than 3% shall be insoluble by continuous hot extraction with benzol and chloroform.

3. On distillation, which shall be made exactly as afterwards described, the distillate, based on water-free oil, shall be within the following limits:

Up to 210° C. not more than 5%.
Up to 235° C. not more than 30%.
Up to 315° C. not less than 35 % nor more than 70%.
Up to 355° C. not less than 65%.

4. The specific gravity of the distillate between 235° C. and 315° C., shall be not less than 1.02 at 38° C., compared with water at 15.5° C. The specific gravity of the distillate between 315° C. and 355° C., shall be not less than 1.08 at 38° C. compared with water at 15.5° C.

5. The specific viscosity at 82° C., when taken in an Engler viscosimeter shall not exceed 1.3. The term "specific viscosity" shall mean the number of seconds found for the sample tested, divided by the number of seconds for water at 20° C. as given in the official certificate for the viscosimeter used.

6. The oil shall not contain more than 3% of water. Oil samples taken by the inspector from the treating tank during the progress of the work shall at no time show an accumulation of more than 2% of foreign matter, such as sawdust and dirt, and due allowance shall be made for all foreign matter, either water or material insoluble in benzol and chloroform, by injecting an additional quantity of oil into the block.

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Testing.

(A) DISTILLATE TEST.

Apparatus.

(a) *Retort.*—This shall be a tubulated Jena glass retort of the usual form with a capacity of 250 to 290 cc. The capacity shall be measured by placing the retort with the bottom of the bulb and the end of the offtake in the same horizontal plane, and pouring water into the bulb through the tubulature until it overflows the offtake. The amount remaining in the bulb shall be considered its capacity. (Fig. 1.)

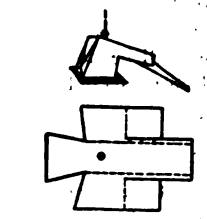
(b) *Condenser Tube.*—Any suitable form of glass tubing may be used; a convenient one is shown in Fig. 1.

(c) *Shield.*—An asbestos shield as shown in Fig. 2, shall be used to protect the retort from air currents and to prevent radiation. This may be covered with galvanized iron, as such an arrangement is more convenient and more permanent.

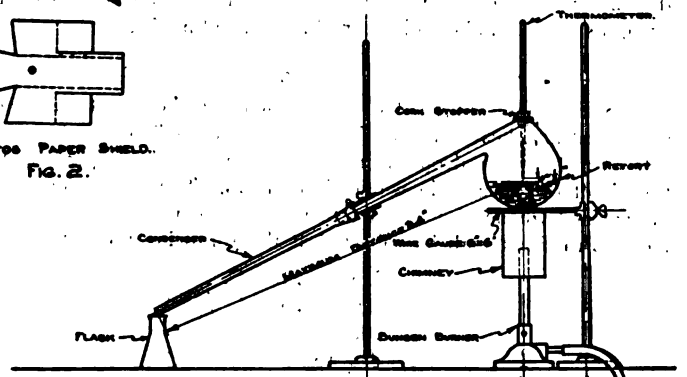
(d) *Receivers.*—Erlenmeyer flasks of 50 to 100 cc. capacity are most convenient form.

(e) *Thermometer,*—The thermometer shall be of glass, well annealed, and shall undergo no serious change at the zero point when heated up to 400° C. The space above the mercury column shall be filled with gas, either carbon dioxide or nitrogen, and the thermometer shall have an expansion chamber at the top.

The scale shall read from 0° to 400° C., in graduations of 1° C., which shall be etched on the stem.



ASBESTOS PAPER SHIELD.
FIG. 2.



STANDARD DISTILLATION TEST FOR CREOSOTE OIL. FIG. 1.

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The tip of the thermometer shall carry a ring for the purpose of attaching tags. The thermometer shall have the following dimensions:

Total length, 375 mm., tolerance 10 mm.
Bulb length, 14 mm., tolerance 1 mm.
Distance from zero mark to bottom of bulb, 30 mm., tolerance 4 mm.
Scale length from zero mark to 400° C., 295 mm., tolerance 5 mm.
Diameter of stem, 7 mm., tolerance 1 mm.
Diameter of bulb, 6 mm., tolerance 1 mm.

When standardized the accuracy of such standardization should be as follows:

Up to 200° C., to the nearest 0° .5 C.
200 to 300° C., to the nearest 1° .0 C.
300 to 360° C., to the nearest 1° .5 C.

Assembling for Distillation Test.

The retort shall be supported on a tripod or rings over two sheets of 20-mesh gauze, 6 in. square. It shall be connected to the condenser tube by a tight cork joint. The thermometer shall be inserted through a cork in the tubulature with the bottom of the bulb ½ in. from the surface of the oil in the retort. The exact location of the thermometer bulb shall be determined by placing a vertical rule graduated in divisions not exceeding 1/16 in. back of the retort when the latter is in position for the test, and sighting the level of the liquid and the point for the bottom of the thermometer bulb. The distance from the bulb of the thermometer to the outlet end of the condenser tube shall be not more than 24 ins. nor less than 20 ins. The burner should be protected from draughts by a suitable shield or chimney. (Fig. 1).

Test.

Exactly 100 g. of oil shall be weighed into the retort, the apparatus assembled and heat applied. The distillation shall be conducted at the rate of at least one drop and not more than two drops per second, and the distillate collected in weighed receivers. The condenser tube shall be warmed whenever necessary to prevent accumulation of solid distillates. Fractions shall be collected at the following points:

Up to 210° C.
Up to 235° C.
235 to 315° C.
315 to 355° C.

The receivers shall be changed as the mercury passes the dividing temperature for each fraction. The last receiver shall be removed at 355° C., and drainage from the condenser, etc., shall not be considered as

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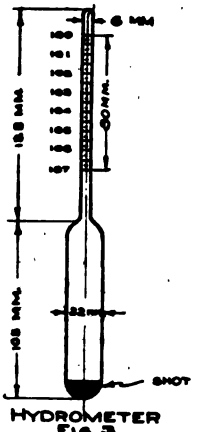
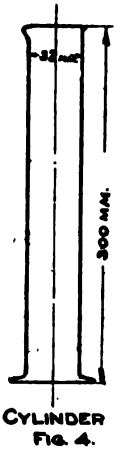
part of the fraction. For weighing the receivers and fractions, a balance accurate to at least 0.05 g. shall be used. During the progress of the distillation the thermometer shall remain in its original position. No correction shall be made for the emergent stem of the thermometer.



HYDROMETER
FIG. 3.



CYLINDER
FIG. 4.

SPECIFIC GRAVITY TEST FOR CREOSOTE OIL.

When any measurable amount of water is present in the distillate it shall be separated as nearly as possible and reported separately, all results being calculated on a basis of dry oil. When more than 2% of water is present, water-free oil shall be obtained by separately distilling a larger quantity of oil, returning to the oil any oil carried over with the water, and using dried oil for the final distillation. A copper tar still is a convenient means of obtaining water-free oil.

(B) SPECIFIC GRAVITY TEST.

Apparatus.

(a) *Hydrometer.*—The hydrometer shall be of the form and dimensions shown in Fig. 3.

(b) *Cylinder.*—The cylinder shall be of the form and dimensions shown in Fig. 4.

Test.

A standardized hydrometer (Fig. 3) shall be used. A set of two with ranges 1.00 to 1.08 and 1.07 to 1.15 will suffice. The reading should preferably be taken at 38° C. (100° F.) because at this temperature almost all oils are completely fluid.

Before taking the specific gravity the oil in the cylinder should be stirred thoroughly with a glass rod, and this rod, when withdrawn from the liquid, should show no solid particles at the instant of with-

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drawal. Care should be taken that the hydrometer does not touch the sides or bottom of the cylinder when the reading is taken, and that the oil surface is free from froth and bubbles. If the specific gravity is determined at a higher temperature than desired, correction should be made by adding 0.0008 to the reading for each degree Centigrade excess of temperature.

S. R. CHURCH, *Chairman.*
HERMANN VON SCHRENK.
H. M. NEWTON.

MR. S. R. CHURCH: I will not read the methods of testing and analysis. These are taken entirely from the recommended specifications of Committee No. 7 on Standard Timber Specifications of the American Society for Testing Materials, printed in the 1915 Proceedings of that Society. I might say that the method of distillation is practically the same as that of the American Railway Engineering Association, commonly known as the standard method of testing creosote oil.

THE PRESIDENT: Gentlemen, what will you do with this recommendation? It is open for discussion.

MR. J. C. WILLIAMS: I assume that Standing Committee No. 1 will be continued; that their work will go on another year under another chairman.

THE PRESIDENT: I do not believe this convention will elect me president, and so I cannot promise you (laughter). I presume that will be done.

MR. J. C. WILLIAMS: It is one of the standing committees of the Association, and its life should be continued.

THE PRESIDENT: Yes.

MR. J. C. WILLIAMS: I have a motion to offer in connection with this report. I would move that the report be accepted as information and referred to Standing Committee No. 1 on Preservatives for consideration, and report at the 1917 convention.

MR. AUGUST MEYER: I second the motion.

MR. S. R. CHURCH: Point of order, Mr. President. As I understood it, it was not necessary for me to make any motion, because I understood from the instructions that the report of this Special Committee was to be presented to the Association for its adoption or rejection. Had I considered it necessary, I would have concluded my report with the usual motion for adoption.

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THE PRESIDENT: Well, Mr. Church, would you consider it rejected if it was referred to Committee No. 1?

MR. S. R. CHURCH: I would like to have an opportunity to confer with the other members of the Special Committee on that point, but it seems to me that this Special Committee was asked to perform a certain piece of work. They have done it, and they have said in their report that they believed that the specification they present is worthy of adoption. Therefore, we can see no reason, if I voice the sentiments of the other members of the Committee, and if I do not I wish they would say so; we can see no reason for referring it to any other committee.

THE PRESIDENT: Gentlemen, there is a motion before the house, that the report of this Special Committee be referred to Committee No. 1. That will be continued for next year. Now, it is open for discussion. Mr. Church has stated his personal opinion. I would like to hear from the other members of this Committee, and then I hope we will have a general discussion, so that we can vote intelligently on the question.

DR. H. von SCHRENK: Mr. President, personally I see no objection to the passage of the motion that has just been made about referring it to the Committee. I wish to say, however, from another viewpoint, that I can see no particular benefit to be obtained thereby. The great trouble with the specification for creosote oil, particularly for wood block paving oil specifications, has been the confusion that has existed for years. I do not think there is any question in the minds of anybody that the one thing needed for wood block specifications today is a standard specification of some sort that will fairly meet the views of most of the people concerned. Now, as Mr. Church has stated, this particular specification, while it looks innocent in the report, and covers only half a page, or thereabouts, of printed matter, really involves an investigation going over a number of years on the part of a great many people. It has been the result of the work of this Special Committee and of manufacturers of creosoted paving blocks, as well as various city engineers composing the Standing Committee on Specifications of the American Society for Municipal Improvements. Now, if we are going to shove this thing ahead another year we are going to have absolutely the same chaotic confusion that has existed in the past. If Mr. Church will allow me to make a remark or two about this specification, I wish to say that this represents a straight coal-tar product, and that it represents, furthermore, an average oil such as is now being furnished under most city specifications, and has the advantage of bringing together the various more or less apparent conflicts in the city specifications in one specification. I personally should regret very much to see that referred back for another year's

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investigation, because I cannot see that very much good will come from it. There might be, and undoubtedly are, certain small changes desirable in some of the clauses, but the question is whether those changes are going to be advantageous enough to warrant our delaying the report another year.

THE PRESIDENT: Mr. Newton.

MR. H. M. NEWTON: Mr. President, I have very little, if anything, to add to what Mr. Church and Dr. von Schrenk have said, except that I feel this, that it is useless to appoint committees to draw up specifications, and to try to get this Association to adopt any kind of standard if the reports furnished are constantly referred to the next year's committee as information.

MR. C. N. FORREST: Mr. President, I prepared a few remarks upon this subject, which I will read as follows: The report of this Committee has been presented and recommended for adoption by this Association upon a different basis from that of the reports of some of the other technical committees, in that no facts have been presented in support of its recommendation. Inasmuch as the specification which it includes is of a highly restrictive character, it should receive the careful scrutiny of this Association before any action is taken toward its adoption.

The remarks of our President at the morning session yesterday in regard to the importance of submitting facts based upon service tests in support of all recommendations of committees or individuals seemed to meet with the warm approval of his hearers at that time. I desire to present a few such facts at this time upon the subject of preservative oils in general for wood paving blocks.

Prior to the year 1900 the only preservative oil in general use for wood blocks was the creosote distillate of about 1.03 gravity, which has been used so extensively for wood-treating purposes, but in 1900 wood blocks treated with a mixture of creosote oil and rosin were laid in Tremont Street, Boston, Mass. That particular pavement rendered excellent service, and established a reputation for creo-resinate blocks, which continued until about 1908, when coal-tar or coal-tar mixture having a gravity of about 1.12 and distilling off about 30% below 315° C., was proposed and used. Now, concurrently with the introduction of such coal-tar mixtures, which were referred to, by the way, as creosote, a refined water-gas-tar having the same gravity and amount of distillate, also came into use as a saturant for wood paving blocks, and has been used extensively for that purpose ever since, as will appear later.

According to the record on the life of treated timber in the United States, contained in the Proceedings of this Association for 1915,

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water-gas-tar was used in New Orleans as long ago as 1889 as a saturant for a wood floor in contact with the ground, and in 1910 was reported as being still sound. Those familiar with the condition of the soil in New Orleans will appreciate the creditable performance of this particular piece of work.

The more recent use of water-gas-tar as a saturant for wood paving blocks, that is, since 1907, has engaged the attention of the speaker in consequence of his connection as Chief Chemist with a paving company which has maintained a wood-treating department since that time, and has confessed to the use of more straight refined water-gas-tar than any other concern engaged in the wood-preserving industry. I can, therefore, state that, collectively, 22,617 sq. yds. of such blocks were put down in the year 1908 in Boston, Mass.; Pittsburgh and Harrisburg, Pa.; New London, Conn.; Havana, Cuba; Zanesville, O., and New York City. Following 1908 the distribution of wood blocks treated with water-gas-tar has proceeded, and millions of them have been laid in various cities. A canvass of some of the earlier work of this character was made by this company the latter part of 1914, and I could read a great many approving letters which were received in response to inquiries sent out at that time. [These are available for whoever may be interested].

Supplementing this evidence the attention of this Association is directed to a report by H. W. Durham appearing in "Engineering News" of December, 1915, in which account is given of the relative performance of three sections of wood block pavements laid in Second Avenue, New York City, two years ago, and from which I quote the following:

> Between Fifth and Sixth Streets Southern shortleaf pine blocks treated with 20 lb. per cu. ft. of a heavy oil having a specific gravity of not less than 1.10 at 38° C. were used. From the south side of Sixth St. halfway to Seventh St. the blocks used were treated with 20 lb. of light oil having a specific gravity of 1.03 to 1.08 at 38° C. From there to the north side of Seventh St. the treatment used was 20 lb. of water-gas-tar.
>
> All types were laid on a 1-in. sand cushion on a 6-in. concrete base, the joints being filled with fine sand and the surface thoroughly rolled and finally spread with a thin coating of sand to be rolled in by traffic. The work was completed January, 1913.
>
> Except for a slight undulating appearance noticeable only on close examination, these pavements are in very fair condition. No difference in appearance is noticeable between the differently treated sections except in extremely hot weather, when there is a slight evidence of oil on the surface of the blocks treated with light oil, but bleeding has practically stopped.

Further instances could be recited of the successful application of water-gas-tar for this purpose, and I have yet to hear of a single failure of blocks so treated. Water-gas-tar, although produced by a different process of gas-making than coal-tar, is of the same general family, and the two tars have many points in common. Both are deprived of water and light oils before reaching the wood-treater, and,

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if anything, there are several features about water-gas-tar blocks which are more desirable than coal-tar blocks. They are equally preserved from decay as far as the continuous use of both kinds for about 10 years has shown. They are equally waterproof, as evidenced by the fact that one type is not more prone to swelling and bulging in the street than the other.

Water-gas-tar blocks are cleaner to handle and of neater appearance than coal-tar blocks, and do not bleed to anything like the extent of the latter. This fact is undoubtedly due to the more homogeneous character of water-gas-tar than of the coal-tar mixture. In support of this last statement I will mention a parallel case in Philadelphia, in which water-gas-tar blocks in Arch Street caused no complaint on this account, while coal-tar blocks on Market Street bled so profusely even the second year as to cause much dissatisfaction. A personal experience in this connection was had but recently, when a contractor in New England inquired how we kept water-gas-tar blocks from bleeding, while the coal-tar blocks he had laid were causing him considerable trouble on that account. Water-gas-tar also loses less by spontaneous evaporation than coal-tar. The water-gas-tar we have used so successfully for this purpose meets the following specifications:

Specific gravity 38/38 C	1.133
Insoluble matter	1.1%
Distillate up to 210° C	Trace
" " " 235° C	1.0%
" " " 315° C	25.1%

Total distillate completely soluble in di-methyl sulphate.

The water-gas-tar, which has been used under the speaker's observation, has apparently been more uniform than the coal-tar used during the same period of time. Back in 1909 and 1910, for instance, the coal-tar was running heavier in gravity, higher in insoluble, lower in distillates below 355° C, and higher in residue above 355° C. than the coal-tar now proposed by the Special Committee. There are also minor differences between the proposed specifications and those referred to as having been proposed last October to the American Society for Municipal Improvements, and which proposal was, by the way, not adopted by that society, but merely received and published subject to investigation during the ensuing year and report at the next convention. The speaker holds no brief for water-gas-tar, except in so far as its general availability and low cost are attractive features. The company employing him is not a producer or distiller of tar of any kind, but it is merely conducting a wood-treating plant and purchasing its treating oils entirely from outside sources. It has treated wood blocks with coal-tar oil of essentially the same character as that proposed by the Special Committee, as well as with water-gas-tar and creosote, and various combinations which may have been called for. There

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are consumers of treated wood blocks who demand other oils and mixtures than coal-tar oil.

The City of Chicago specifies a creosote distillate oil, and there is ample evidence of the sufficiency of other oils or tars than the one proposed by the Special Committee, and which are not so restricted as to source of supply as the latter is. I, therefore, have to propose the following specifications for a water-gas-tar preservative. The preservative shall be refined water-gas-tar having the following characteristics:

It shall not contain more than.....2.0% water
Specific Gravity 38/38 C.....1.11 to 1.14
Insoluble by hot continuous extractions
with benzol and chloroform.....Not over 2.0%
On distillation, the distillates shall be within the following limits.
Up to 315° C.....Between 25 and 50%
Up to 210° C.....Not more than 20%
Up to 235° C.....Not more than 5%

The preservative proposed by the Special Committee may be presumed to also be suitable as a saturant for wood blocks, but no evidence has been presented to that effect, as we have before remarked. I, therefore, have to suggest that in submitting the report of the Special Committee for the further deliberations of any other committee of this Association that the specification for water-gas-tar be also called to the attention of that committee, and that the committee in charge of the preservatives be furthermore instructed to consider both specifications, and to investigate all preservatives upon which facts as to service tests are available, and include such facts in its recommendations, and report to the annual meeting of this Association next year.

MR. L. I. PARMINTER: I would like to ask Mr. Church whether this specification will or will not permit of a tar mixture, and how much.

MR. S. R. CHURCH: This specification permits the use of either a distillate creosote oil or what the American Railway Engineering Association now term a creosote coal-tar solution. The percentage of tar which can be used in the oil under this specification will not exceed on an average 35%.

THE PRESIDENT: Any other question?

MR. W. S. HAMNETT: If this specification is going to permit the use of a certain percentage of tar, straight distillate oil, I do not see how it can be reconciled with the statement by the Forest Products Laboratory in their last bulletin to the effect that coal-tar is not a good preservative, and its use is not recommended.

THE PRESIDENT: Any other questions? Now, before putting

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this question I want to give Mr. Church the opportunity to answer. I want everybody to have his say, but you have got to be on your feet.

MR. ALLAN W. DOW: Mr. President, I might say that while I do not officially represent the American Society of Municipal Improvements, I am the only member of the Committee on Wood Block Paving of that society present, and as it is the report which I presented at the Dayton meeting which your Special Committee has seen fit to recommend for adoption, it might be interesting to you and the members to hear of the difficulties encountered by past committees of the American Society of Municipal Improvements in formulating specifications for the manufacture and laying of wood block paving.

I believe it is now seven or eight years since I first took up serving as a member of the Committee on Wood Block Paving of the American Society of Municipal Improvements. At times I have been chairman of this committee, and at others merely a member. I might say that without exception every man who has served on this committee has been of the opinion that the oil to be specified as preservative should be of the highest grade in every respect. We have believed it to be the province of the committee to only recommend what we considered the best material, even though other preservatives have given very satisfactory results. If we had opened up the specifications so that any kind of oil could come in, it would not have been long before some parties would have desired to use petroleum, and in my opinion petroleum is just as suitable as water-gas-tar, for it is waterproofing, and usually as antiseptic, but we have felt that even though water-gas-tar has given good results in a number of cases, it was our duty to recommend an oil that had high preservative properties. We have also definitely concluded among ourselves that the light distillate oils are not suitable for wood block on account of their volatilization, and this point has of late been so thoroughly proven by the many experiments reported from different laboratories that the wisdom of our selection has been amply demonstrated. We have, of course, considered water-gas-tar, but this has practically no preservative properties, and unless we could be assured that every part of a block was thoroughly waterproofed with it, we did not feel justified in allowing it in competition with the higher preservatives. There have been many cases where blocks treated with water-gas-tar have decayed in the street, and in many instances this decay has occurred in the portion of the wood saturated with the water-gas-tar. Washington Avenue, in St. Louis, is one of the most striking illustrations of this. Besides this street, there is Washington Street, in Boston, and streets in Baltimore, Md., and Charleston, S. C., that were treated with water-gas-tar and rotted badly.

As to the relative amount of bleeding of blocks treated with

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water-gas-tar and coal-tar oil, I think Mr. Forrest is unfair in his statement by comparing Market and Arch Streets, Philadelphia. Our firm had the inspection of both of these jobs. The Market Street pavement was laid under a peculiar specification, which required a low absorption, and while they only required 20 lbs. of oil to make the blocks meet the low absorption, we were obliged to inject 24 pounds, and in many cases as much as 26 lbs., into these blocks. When one considers the large amount of oil used, it is most remarkable that so little bleeding took place. The Arch Street pavement was treated with 20 lbs. or less of oil.

Now, gentlemen, it is my belief that we will never be able to draw up standard specifications until different members of the society appreciate just what this means, and I believe that in a subject where there is such a great diversity of opinion it would be the place of the Chairman of the society to instruct the Chairman of the Committee as to just what is required of the standard specifications. Is the Committee to only recommend the very best material, or is it to recommend numerous materials which have all proven satisfactory? As committees are only working for the society, it surely seems that such instructions are necessary, so that year after year their recommendations would not be turned down. It is very possible that these committees do not know what is required of them.

MR. GEORGE E. REX: Mr. Chairman, there seems to be two questions here: First, the disposition of the Committee report, and, second, the merits of the specification. The convention has a Standing Committee, appointed in good faith at the beginning of the year to work out this proposition. Later in the year, after numerous and urgent requests on this Committee to do something, our President has honored these gentlemen by asking them to bring in a report. To ask this convention after this extensive report has been made to refer it back to the Committee again for the coming year, I think is unfair. So much for the disposition of the report. As to the merits of the specifications, I think the desire of every creosoting man, and certainly every consumer of creosoted material, is to try to get accurate knowledge of what should be used in his timber.

I think it is the consensus of opinion of the whole treating fraternity that we are very safe when we come down strong and say that a coal-tar product is the advisable one to use. I do not mean by that that our water-gas-tar people have no merit in their creosote, but I do not think that the treating fraternity as a whole is willing yet to allow a specification that will allow water-gas-tar to be used unknowingly with a coal-tar creosote. Let us use our coal-tar creosote as such,—water-gas-tar creosote as such. Let us do it knowingly. Let us do it so that we will know what we are buying, and this specification

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is, I think, written so that we will be absolutely assured that we will get a coal-tar product. I believe that 90% of the members of this Association, as well as the American Railway Engineering Association, are absolutely in favor of standing out for the coal-tar product, as a coal-tar product, and not as a mixture. Any specification that will make that perfectly plain, make it perfectly understood, I think is what we want.

DISCUSSION ON PRESERVATIVE SPECIFICATIONS FOR WOOD PAVING BLOCKS.

By A. E. Larkin.

The discussion up to this time shows that members of this Association realize that it is necessary to go into the matter of adoption or rejection of a report of this kind very slowly, in order that no mistake is made.

The American Wood-Preservers' Association must rigidly adhere to this "safety first" policy, in order that it maintain its high standing in the community, and that by proceeding logically and carefully it will not have to reverse itself later on because of a standard adopted hastily or without the proper analysis and consideration.

We have been very slow to adopt standards. We must proceed slowly and carefully with reference to adopting specifications. I do not know of any standard that this Association has adopted up to this time. We are talking about a Manual and we hope very soon to get one started. That Manual must contain the very best information that this Association has available. There must be nothing published in the Manual which will carry the approval of this Association except the standards that have received the most careful thought and study of the members. This should be our idea of "safety first."

Consider for a minute the safeguard clause in your 1915 Constitution, Article X, Section 1 designed to prevent the adoption of standards hastily or without careful consideration:

> Any proposed standard specification must be presented at the annual meeting, at which it may be amended by a majority vote of the Corporate and Honorary members present and voting. A two-thirds (⅔) affirmative vote of the Corporate and Honorary members present and voting shall be required to refer the specification to letter ballot of the Association.
>
> A two-third (⅔) affirmative vote of all Corporate and Honorary members of the Association shall be required for the adoption of the specification.

We take great pride in the knowledge that the membership of our Association includes the cream of the men interested in wood-preserving industry. The other associations, such as, for instance, the American Railway Engineering Ass'n, have comparatively few members who are directly interested in wood-preserving, and those men are usually

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chosen to serve on the Wood Preservative Committee. The results obtained by those special committees can hardly be compared to those obtained from the deliberations of our Association. Our entire membership constitutes a committee of the whole that has to do with wood preservation alone. Therefore, because of the prominent place our Association occupies in this field we must be a whole lot more careful than any of the other associations in our recommendations. We concentrate on wood preservation alone, while the other associations consider wood preservation as only one of many items they must deal with and report on.

The paving oil specification submitted to this Association is the same specification that was presented to the committee having the matter in hand for the American Society of Municipal Improvements by a sub-committee at its annual meeting at Dayton, O., October, 1915. The specification was not presented to nor adopted by the convention at Dayton. But the Committee did not present it to the Society.

After it is developed in the previous discussion that this very specification under consideration now does not actually and in practice bar its use, it has just been stated, for instance, that water-gas-tar is not the best wood-preserving material, and that it is not quite as high a standard as should have been specified.

An answer to one question just a minute ago said that this specification will cover the use of pure creosote oil, and to another that this specification would allow the use of 35% of tar. The Forest Products Laboratory tells us that the tar is not a good preservative. So here we are considering the adoption of a specification that will allow the use of pure creosote oil alone, or 35% of tar mixed with creosote oil, or several other things. In other words, it is not a specification that has so far been brought down to mean one thing, or that even confines the resulting oil within reasonable limits. The limits are so broad that most anything can be used.

With a specification of that kind to work on, what will the contractor furnishing wood paving blocks do? Will he quote prices based on furnishing the pure creosote oil when his competitor can bid on furnishing 35% tar, and still both be in line with the specification? If there are three or four contractors furnishing paving blocks on a large contract to the same city, is there any chance that if they worked under this specification the material would be uniform? Is it not absolutely necessary that an engineer get a material, for paving especially, that is uniform? If it wears out quickly, and wears uniformly, even that result is a lot better than if one part of the pavement wears fast and another part of the pavement wears slow, and the resulting surface is not uniform. Well, there is no chance that the material furnished under this specification will be a uniform product unless a

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contractor happens to have a very large supply of preservative all of one kind, and is the only contractor furnishing the city requirement.

If the engineer in charge wants a high-grade distillate oil, which the Committee says can be furnished under this specification, he will be unable to enforce its use, because the contractor will be able to show his adulterated oil will meet the specification.

More attention and space in this Committee report should have been given to the specification, so that we might know positively what is being specified, rather than have so much emphasis given to the matter of testing this oil.

The method of testing is all right, and the description of the apparatus is all right, but they divert the attention of the Engineer and Municipal officer from a study of the merits of the oil set out in the specifications to the consideration of the very accurate apparatus which must be obtained for use when this specification is adopted.

I do not know whether the Committee is justified in saying that this specification reflects the judgment of the majority of leading authorities or not. I am directly connected with the creosote industry. I believe I am quite familiar with the creosote specifications extant, under which blocks are being treated, and have been treated, and am in direct touch with many of the engineers using this type of pavement, and also with the production of creosote oil; and I have not heard among them, or from any of them, any reference to this particular specification. The city of St. Louis has a specification similar to the one published in WOOD-PRESERVING last July. I think the St. Louis specification was just adopted this past year. But I know of no other city having a specification anywhere similar to it. It is possible, however, that in some specific, isolated cases the proposed specification, without full consideration of it, has been adopted, but I know of no city now using it, and of no authorities advocating its use.

Now, I want to bring this point home to you. We are not ready to adopt a specification. Discussion here today shows water-gas-tar is under consideration, and there are several other specifications worthy of consideration that have not yet been discussed. We must not adopt a standard at this time that we will have to change in a few months, or even a year or so. We want to have something to present to the public and to the municipalities and to the engineers that will be the best material available for the purpose of its use,—then we will not have to reverse ourselves later on.

To further emphasize this situation I would say that if the specification for a mixture of 70 to 75% coal-tar and 25 to 30% creosote oil, which was presented at the convention of the American Society for Municipal Improvements in Boston in 1914, had been adopted its use would be prohibited by the specification which was published in

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the July issue of WOOD-PRESERVING over the names of our Committee, and by the specification which is now presented. Again we find printed a specification by the same Committee. I would like to have you see the difference in the specification that was submitted at that time, and the one that is submitted now. I want to point out to you just which direction it is going in, and obviously why it is changed. The object sought by these numerous and varied specifications is solely to establish the use of a large quantity of tar in mixture with creosote oil. Let us call your attention to the difference between the specification published in July by this same Committee and the present proposed specification.

Published in WOOD-PRESERVING, July, 1915.	Present Proposed Specification.
Sp. gravity of oil 38° C. 1.07 to 1.11	1.06 to 1.12
Distillation to 210° C., not more than 5%	Not more than 5%
" 235° C., " " " 30%	" " " 30%
" 315° C., " " " 50%	" less than 35%
	Nor more than 70%
" 355° C., " " " 70%	Not less than 65%
Distillate, 235° to 315° (Sp. G. 38° C.)	
not less than.....1.03	" " " 1.02
Carbon not more than.....2.5%	Not more than 3%
Specific viscosity, 82° C. (water 20° C.)	
not more than.....1.20	" " " 1.30

You will observe that the range of gravity in the specification published in WOOD-PRESERVING is 1.07 to 1.11, a range of four hundredths; that there is a definite quantity of each distillate up to the different temperatures; that the viscosity at 82° C. is not more than 1.20.

In comparison the gravity of the specification now submitted ranges from 1.06 to 1.12, and the distillate up to 315° C. ranges from 35 to 70%—a range that no City Engineer would accept; because the resultant work would be too varied, for if a stable oil was wanted the contractor could use a volatile oil, and if a volatile oil were wanted the contractor could use a stable oil; the quantity of distillate up to 355° C. is placed at not less than 65%, so all or only 65% could distill off up to 355° C.; the viscosity at 82° C. is increased from 1.20 in the specification published in WOOD-PRESERVING to 1.30. The increase in the viscosity from 1.20 to 1.30, the increase in gravity from 1.11 to 1.12, and the increase in carbon from 2½% to 3%, make the open door by which an increased quantity of tar can be added to the oil. And you will also observe that the specific gravity of the distillate between 235 and 315 in the specification published in our WOOD-PRESERVING last summer is 1.03, and that in the present proposed specification it is reduced to 1.02; that is, a lighter and inferior oil is, or may be, now introduced if these specifications are adopted.

Kaleidoscopic specifications and presentations of them should cease, especially those with the unsound basis that a specification for use in municipal paving should be so drawn that a large quantity of

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coal-tar can be used in mixture with the more volatile portions of creosote oil without this fact being set forth understandingly in the specifications.

It is really a question in my mind whether or not a specification of this kind is legal. The very essence of a specification is lacking, because it does not clearly define what the engineer is to use. The contractor can use so many different things that if a question of quality of the preservative came up, it is not certain whether this specification would determine the proper quality that should have been used or not.

Most of you, I hope, were here when Mr. Kendrick made his opening address. Only one of the many pertinent things he said was that there were too grave considerations given to the first cost of material entering into the preservation of cross ties. His statement was, however, pretty general in its reference to wood preservation of all kinds. He made a strong plea to this Association to compile figures that would extend over a period of time, and show not only the first costs on treated material, but also the ultimate costs. He wished to see figures compiled showing the first costs plus renewals and maintenance.

Figures of this kind would show then positively whether a preservative treatment including the use of the cheap available preservative was economical or not. It is to be hoped that this suggestion, which is only one of the many first class suggestions made by Mr. Kendrick, will be followed out, for work done along this line would give us the most valuable data that could be obtained.

It looks to me, from the study that I have made of this specification, that it is one drawn in the interest of coal-tar distillers; it certainly is not for the good of the wood-preserving industry.

In the specification published last July it was stated it was drawn for the express purpose of limiting the amount of coal-tar added to creosote oil. I believe it was thought that 20% should be the maximum that would be allowed under the specification. As a matter of fact, this oil could be made up of approximately 50% creosote oil and 50% of tar. With the increase in gravity, the increase in viscosity, and the increase in carbon in the specifications submitted here, a mixture could be made of which more than one-half would consist of coal-tar.

I know it can be said of the specification that one would not have to use tar, but could use pure creosote oil only; that the distillation requirements and gravity permit the use of the pure oil. This very looseness of requirement in the specification brands it as unsound. City Engineers would know, first, that if they would allow this great variance in the quality of material, they would get the tar mixture

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instead of the pure creosote oil; second, that the tar mixtures would vary in quality, and the resultant work would vary greatly; third, that under this specification wood-preservers would use the tar mixture, for that is the real purpose of the specification. The City Engineers who are acquainted with the qualities of creosote oil, and the kind of oil needed for wood block, will not accept this specification; those who are not skilled in it might accept it because of the impetus the adoption of it by this Association would give it. But its quality is so poor that the error would soon be discovered, and they would rebel against it, and condemn this Association for having submitted it. It might even be that if this Association adopts this specification now that the American Society for Municipal Improvements would follow our action at their next convention. But nothing more harmful could be done to those who are interested in the success of creosoted wood blocks than to have such a specification adopted, for its life of necessity will be very short.

We must not adopt a specification that would not prove to be perfectly sound in every particular, and give us lasting and the very best results. There is no doubt but that this specification might appeal to some people because of its cheapness and its availability, but should not this Association always go on record for raising the standards, keeping them high, and working always toward that end? If we cannot advocate and adopt a standard of any kind that is the highest and the best, then let us not adopt any.

Let the gentlemen who submit this report, and who have done a whole lot of work on the problem (they have explained that their investigations have covered a term of years, and that many people have done a lot of work on this report) continue their research work. I believe that perhaps the specification that they would come in with another year might be something different. The report next year will probably be the better for the additional time spent upon it, and we, of course, would derive the greater benefit. Let us not adopt this specification in the course of its construction, and that is just what we would be doing if we were satisfied to accept and approve of this specification now.

The American Railway Engineering Bulletin of 1914, Vol. 15, page 680, contains a very able article by Dr. von Schrenk and Mr. Kammerer, from which I quote:

> The writer firmly believes that the best result with creosoting will always be obtained by the use of oil equivalent to the American Railway Engineering Association No. 1 oil.
>
> They wish to point out distinctly that in their opinion refined coal-tar should never be added to the American Railway Engineering Association's No. 1 oil.

And in the same volume, page 627, the Committee of the American Railway Engineering Association, under the head of "Wood Preservation," states that:

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> The Committee recommends that wherever possible only grade No. 1 coal-tar creosote should be used, and that under no circumstances should coal-tar be added to creosote of this grade.

In the American Wood-Preservers' Association Proceedings for 1914, Dr. von Schrenk says:

> Personally I have always felt that it would be a good thing for the creosoting industry if we never had any coal-tar.

Now, these men know that the pure creosote oil is the best to use. We also know that a higher grade of oil is required for paving blocks than is required for ties. City Engineers who have to do with municipal block paving understand that wood paving blocks require a better grade of creosote oil, not a more inferior grade, than is required for tie purposes. Paving blocks are subject to heavier and harder wear. It is hardly necessary to mention that the exposure and the wear of creosoted wood blocks in a street pavement is severer than that of a tie in a roadbed; and that the oil used in treating paving blocks must be of the very highest quality. I wish to enter my heartiest protest against the adoption of this specification at this time. Thank you,

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MR. W. H. FULWEILER: Mr. Chairman, I am afraid I was one of the members of Standing Committee No. 1 that felt a little aggrieved; at least you referred to me. I felt that it was rather unfortunate that the individual members of that Committee had to be branded as incompetents and slothful on account of their Chairman (laughter).

The particular point that I want to bring out regarding this report is the one that I have tried to bring out for the past four years that I have been attending these meetings. I occupy the same position with my company that Mr. Church does with his. We are producers of oils for wood-preserving, so that both of our remarks may be considered as equally disinterested. I do not know whether you remember me or not, but I have always been standing for one thing, and that is, let us so arrange our specifications that the men using the material know what they are getting. In other words, this is an era of pure food labelling, particularly with products that enter into interstate commerce.

It is well known that for years water-gas-tar has been used sub-rosa, and, to a certain extent, openly. Now, I think, with particular reference to the wood-paving industry, that water-gas-tar has just as good a history as these so-called creosote mixtures. I think enough has been said, enough facts have been presented to show that there is not a universal feeling that the specification recommended by this Committee is one that we are ready to adopt as a standard specification. I think this is an age of efficiency, but it would seem curious to

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take an oil that may be poorer than a Grade 3 A. R. E. A. oil, which is not supposed to be good for treating, and by mixing it with, let us say, 50% of a filtered or low-carbon coke-oven-tar or vertical tar, and get a material which this Association is asked to say is the only standard material for use in the preservation of wood paving blocks. That is certainly an engineering job, to make two poor things into a standard.

I feel that the situation as it stands at present is, that there is a diversity of opinion regarding what is the best oil to be used. Therefore, why not let this Association, through its Committee, or how it will, say to the people of the United States that have occasion to specify wood-preserving oils through a report which should contain all the available data, gentlemen, certain materials have been used for treating wood paving blocks, they have given successful results. We are not absolutely sure which one is the best, but here are three or four, or five, maybe, perfectly clear-cut, close specifications that will insure your getting just exactly what you think you are getting. I think that is the only fair and logical way that we can attack the problem in the present state of our knowledge.

The present specification does not absolutely insure your getting anything. It has been said that it will permit the use of a straight distillate coal-tar. I think it is universal experience that what you get under a specification is the cheapest thing that the contractor can get by with. So you know you would never get a straight distillate coal-tar under the present specification. Furthermore, the present specification calls for a material composed entirely, I think it reads, of coal-tar or coke-oven-tar. The limits set forth in that specification do not insure that. You can use, I am safe in saying, up to 20 or 25% of water-gas-tar. I have some figures that show at least 20% of water-gas-tar can be put in, and I understand Mr. Campbell has some figures that show that even 25% of water-gas-tar can be used under that specification. Now, I think that, on the face of it, would be enough to show that this specification is not such that would absolutely insure getting what you call for, and is not in such shape that this Association can adopt it as a standard. I feel that other materials, such as water-gas tar, have, by virtue of equally successful service tests, and equally long service tests, shown that they are worthy of consideration. Moreover, just one point, I do not find any available data or literature showing that one gallon of the particular oil recommended by this specification has ever been used anywhere. It seems to me until such information is brought out we must be in the position of considering it purely as a specification for those who happen to be able to furnish that grade of material with the greatest ease.

THE PRESIDENT: Mr. Buehler.

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MR. WALTER BUEHLER: Mr. President, I have had occasion in the last four of five weeks to look over a lot of creosoted block pavements in the city of Indianapolis. Some of these pavements were laid in 1896, some in 1898, and then from 1898 on up to last year or year before last. The pavements laid in 1896, some were untreated, but I want to speak particularly of those that were treated. The wood was Washington cedar, and the blocks were dipped. I do not know what the character of oil was that was used in preserving these blocks, but I understand from looking back in the record that from 4 to 6 lbs. of the oil was absorbed per cubic foot.

In 1898 and 1899, and I believe in 1900, the blocks were treated with about 10 lbs. of oil under the pressure process. The oil used at that time was put in under the trade name of Kreodone. It was an oil with a gravity of about 1.07 to 1.09, a substantially heavy oil. In 1902 and 1903 the specification called for an oil that should have not less than 35% naphthalene,—get that, not less than 35%, and tar acids of 5%. The specification was then changed to an oil of about 1.15 gravity, and permitted of an admixture of coal-tar. The interesting point that I want to bring out is this: You go over the various pavements, and the thing that you are impressed with is that there is very little difference in the quantity of decay. The blocks that were treated back in 1896 show very little decay, and they were dipped blocks with 6 lbs. of oil. There is very little difference between these blocks and those that were treated in later years with 1.15 gravity with 20 lbs. of oil. All of the pavements have given a great deal of trouble in Indianapolis, due to bulging and swelling. There seems to be very little difference between those that were dipped and those that were treated with 20 lbs. of oil.

Now, on the other hand, in Minneapolis, with the exception of one street, the quantity of oil has always been 16 lbs. per cubic foot. Minneapolis has a great many more yards of pavement than Indianapolis, and the oil used in the treatment of pavements in Minneapolis to my positive knowledge has been light oil, as light as 1.02 and 1.03 gravity, has been mixture of water-gas-tar, as high as 85% water-gas, has been coal-tar and creosote mixture; in fact, it has been about every kind of oil that you could mix together to fulfill a specification calling for certain distillates, percentage of distillates only. The pavement in Minneapolis has given very little trouble due to bulging and swelling. It is absolutely remarkable the small amount of trouble they have had there due to that cause which we all recognize as one of the greatest faults in the wood block pavement, and one we have been working hardest to overcome, next to the bleeding, which has only been a matter that has come before us the last two or three years.

The point that I want to bring out is this: Take these two cities; it appears to me that there is something besides the quality of the oil

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necessary to make a successful paving block, and while I realize that a committee of this Association, appointed to recommend an oil specification, should not have anything to do with the other features of the wood block paving, the construction features, for instance, I firmly believe that a specification treating with the preservative alone would not be complete without the specification dealing with the construction and other features of the pavement. There unquestionably must be something in addition to the quality of the preservative entering into the successful block pavement.

THE PRESIDENT: Gentlemen, it is 12:20. I am willing to stay here until tomorrow morning if they will leave us, but I think we should give Mr. Church a few minutes. We will continue the discussion till you people say you want the question put to the house.

MR. S. R. CHURCH: Gentlemen, I will be very brief in my remarks. Mr. Buehler's discussion on this subject is irrelevant. There is another committee dealing with the construction of wood block paving. Now, gentlemen, kindly bear in mind that your Special Committee was asked to do one thing, recommend a specification for a preservative for treating wood blocks. That is what they have endeavored to do.

Mr. Fulweiler says that under the specification that we have presented the contractor will endeavor to get by with the cheapest material possible. Your Committee fully endorses that statement. That is just exactly what they expect the contractor will try to do. Mr. Larkin said that under this specification a mixture of coal-tar and distillate creosote oil would be used, and that is just exactly what your Committee told you.

Your Committee submits, in the best of its judgment, in the best judgment of the engineers and chemists with whom we have conferred for a number of years, that the requirements of this specification are such that the mixture will be controlled more definitely and within closer limits than has been done in previous specifications. Your Committee also submits these facts, that in about 75% of the cities of the United States mixtures of coal-tar and distillate creosote oil have been used for a great many years in treating wood paving blocks. There is nothing new about this specification, gentlemen, except that it is an attempt to enforce within reasonable limits the practice which, under loosely-drawn and widely-varying specifications, has been prevalent throughout the United States. Furthermore, there is nothing new in the use of such mixtures in treating timber generally. There are men here, a number of them treating plant operators, who have used such an oil and know what can be done with it in the way of obtaining satisfactory treatment.

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I am very glad that Mr. Larkin criticised the length to which we went in defining methods of testing because neglect of this detail has been the cause of more trouble and confusion than anything else. If we have succeeded, and I believe we have, and I am not speaking on behalf of this Committee now, but on behalf of the committee of the American Society for Testing Materials which did the work, if we have succeeded in presenting a clean-cut method for testing oil, why, that is a step in advance, and it is worth the few pages of paper on which it is written. Mr. Larkin has stated that under this specification a mixture of 50% distillate oil and 50% tar can be used and Mr. Fulweiler went him one better and said you did not even have to use good creosote oil. Now, gentlemen, in the opinion of your Special Committee, Mr. Larkin and Mr. Fulweiler are mistaken. Your Committee has already stated that 35% was the limit, and we believe that to be the case. We also stated in making this mixture it is necessary to use a good grade of creosote oil which, if you care to judge it by Maintenance of Way standards, would have to be at least Grade 2 oil and not Grade 3 or anything inferior to that.

One of the speakers has also inferred that adulteration of the oil with water-gas-tar is possible under our specification. In the opinion of the Committee, no specification has ever been prepared that will absolutely prevent any such adulteration, but in our judgment this specification practically does so, to a greater degree than has heretofore been accomplished. What your Committee desires to emphasize is that this specification admits as wide range of materials as properly should be admitted, but that any oil meeting these requirements will be admirably adapted to treatment of wood paving blocks.

Now, I believe Dr. von Schrenk wants to say one or two words more, and your Committee hopes that any further discussion of the paper will be to the point and that the issue will not be clouded.

DR. H. von SCHRENK: Mr. Chairman, may I have a word or two? I will be very brief in my statements. It appears to me this discussion has brought out two very sharply drawn points of difference of opinion. The first one deals with the question as to the relative desirability of recommending a straight coal-tar product or a water-gas-tar product. Your Committee was undivided in its opinion that the safe thing to recommend as a standard was a coal-tar product.

We have nothing essentially against the water-gas-tar product at all, except the rather startling point that we have been absolutely unable to find any of these so-called records which we have heard about this morning. I took occasion at the annual convention at Dayton to ask the gentlemen who spoke for the water-gas-tar industry if they would not kindly furnish our Committee or the Committee of the American Railway Engineering Association, or the Committee of the

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American Society for Testing Materials, with these data. Two or three of them jumped upon their feet and said they had them tabulated and would immediately mail them to me. That is the last I ever heard of it. They absolutely failed to send in the records. We have had three or four committees of the American Railway Engineering Association, the American Society for Testing Materials and I do not know but that this Association may have had a committee who have been delegated to find these records. We have not any of us been able to find these records, and I may furthermore say in the investigations which your Committee has made, we have made several thousand analyses of wood-preserving oils from all parts of the United States in the last six or eight months, and the only failures, as I will show you this afternoon, by some actual pictures, the only failures of treated material, that is, wood fibers impregnated with oil, were in cases of oil that had water-gas-tar constituents in them. With that as a basis we did not feel like recommending to this Association or to any organization to take any chance. Consequently, we recommended a straight coal-tar product. Time may show that we were mistaken in that and that we should also have recommended a water-gas-tar specification.

I am certainly the first one who will stand up and say when we do get these proofs which will warrant our recommending to the consuming public of this country that they should use water-gas-tar products, I will be the first one to do so. The second point was lightly touched on by several speakers, that is, as to changes which were made in specifications from time to time. Now, gentlemen, one of the chief reasons why there was a difference in the specification as promulgated in July or August, as it may have been, and the present specification was to admit into that specification the high-grade distillate oils.

Gentlemen, the time has come when this business about drawing a definite percentage for a creosote oil specification has got to stop, or we are going to have some trouble in this industry. There is not any question in my mind whatever about that, and I have no hesitation in making the flat-footed statement without fear of contradiction that it does not make a particle of difference practically from the standpoint of lasting as to exactly what percentages you have in oils, whether it is a distillate oil, or an oil with a reasonable amount of coal-tar products. The experience in European countries has amply demonstrated by numerous reports to the American Railway Engineering Association, and any of you can find those that want to, that there has been a divergence of opinion among them for the last 75 years or longer as to what the percentage of tar acids, napthalene and anthracene compounds should be in oil. Look over the wood-preserving in the United States, from the Atlantic to the Pacific, and we all know we have had 45 or 100 different oil specifications. I heartily endorse the statement made by one gentleman here this morning that in the investigation

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made by your Committee this last year in all the cities in the United States we have found no occasion of failure by decay of treated piles or other timbers, as I shall show this afternoon. We found numerous cases in wood block pavements, but in no case where the wood was actually impregnated with oil did it fail by decay. Is that not a pretty good indication that we are wasting a lot of time talking about various percentages, various distillates, various specific gravities and so forth, and is it not about time that we stop this sort of thing and get together on some general standard. I may say that the Committee glorified in the mental and physical and chemical juggling which we performed of doing the very thing which we are now accused of doing, namely, making a specification wide enough so as to make it possible that any good coal-tar wood-preserving oil can be furnished under the specification and take away from the mind of the general public the fact that the specification for the preservative is the most important factor. The rest of the Preservative Committee will present the other considerations, Mr. Church has said, but I think it is high time that we face the issue squarely, and simply come out flat-footedly and say that we want any kind of coal-tar creosote oil or water-gas-tar if they may be warranted, but let us stop continually discussing the particular percentage of various compounds that are necessary, because, gentlemen, it does not make a bit of difference what you put into the preserving oil as long as you have fairly reasonable limits which will warrant a stable oil and penetrating material and material of sufficient toxic qualities in order to serve the purpose for which they are intended. That, in brief, is all that this Committee has tried to do. We were instructed to get up a general specification which would be applicable, which would serve its purpose, and we have presented that specification for your consideration. Now, as I have said before, it is not positive proof, but at least it has this advantage that it is generally applicable, and I defy anybody to prove to the contrary that this is a closed specification. It admits the highest straight distillate oil. It admits distillate oil with coal-tar with a limit not to exceed 35% of the latter. We have tested them all, and if we have erred in brevity in this report, it is because we have had some consideration for the treasury of this Association. We might have written a small Webster's dictionary of the work that was done to elucidate the various points, but we did not consider that necessary. We were asked to prepare a compromise specification which would be generally applicable, and we have done that to the best of our ability.

THE PRESIDENT: Mr. Loud.

MR. H. S. LOUD: Mr. President, I do not know that I have anything to add to what has already been said on both sides of this question. I have been engaged in the manufacture of wood blocks for possibly nine or ten years, and from the very start we have been using large quantities of water-gas-tar in our mixture, except on contracts ex-

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cluding its use. We have gone on the general principle that the treatment of a wood block required a different oil from the treatment of a tie or structural timber; that we needed a certain quantity of straight creosote oil for its antiseptic qualities and that we needed something else (which at one time with us was rosin) for waterproofing. We have found that the waterproofer may be either a good grade of water-gas-tar oil or the tar that you get from mixing a filtered coal-tar with the creosote oil. I have not seen any particular difference between the blocks which are treated with one kind or the other. That covers an experience of nearly ten years.

THE PRESIDENT: Gentlemen, what is your further pleasure?

MR. W. S. HAMNETT: I would like to ask if this specification is designed to admit 35% adulteration, why it does not say so instead of clouding the thing up with a lot of technicalities?

MR. S. R. CHURCH: The question as to whether or not the addition of coal-tar to creosote is an adulteration may be left to the doctrinaires. We say that it is not. Dr. von Schrenk says it is not an adulteration. I do not care whether you call it adulteration or not.

MR. W. S. HAMNETT: Then, why does the Forest Products Laboratory say the use of tar is not recommended, Mr. President?

THE PRESIDENT: Do not ask me. Ask the Forest Products Laboratory, (laughter).

MR. C. M. TAYLOR: Mr. Teesdale wants to know where the statement comes from that coal-tar is not recommended as a preservative.

MR. W. S. HAMNETT: Mr. Chairman, that appears in the last issue of the paper called WOOD-PRESERVING, under the subject of treatment.

THE PRESIDENT: Unless someone calls for the question, I will recognize every man in the order they come.

MR. C. H. TEESDALE: That paper refers to the treatment of fence posts, and it states that coal-tar is not recommended for brush oak, for the treatment of that timber.

MR. J. H. CAMPBELL: I would like to say something of a purely chemical nature on manipulative detail.

THE PRESIDENT: How long?

MR. J. H. CAMPBELL: It will not be very long. Clause 4, on page 2 in the specification, says:

> The specific gravity of the distillate between 235° C., and 315° C., shall be not less than 1.02 at 38° C., compared with water at 15.5° C. The specific gravity of the distillate between 315° C. and 355° C., shall be not less than 1.08 at 38° C. compared with water at 15.5° C.

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Why not compare at 38°C? In chemical work there is too much of this juggling back and forth of specific gravity temperatures. Why not take it at 38°C and compare it with an equal volume of water at 38°C? Further down in Section 5, I think it should state that the viscosity is to be made on the dry oil. It does not so state. A man when submitted a sample of oil could not make the viscosity on the dry oil under this specification.

MR. A. E. LARKIN: You will agree that whether you are for or against the arguments we prepare and bring before you, at least, you give them sufficient attention to criticize and tear them to pieces if we leave you an opening. We are aware of this fact and therefore do not come before you unprepared or attempt to submit for your careful consideration an argument or discussion that we cannot in every way support with facts.

I have stated that a mixture of 50% creosote oil and 50% of tar would fill the specification submitted by this Committee last July. I also stated that the changes made in the specification by this same Committee since that time and which you are asked to adopt as a standard today will permit the use of a mixture containing more than 50% of tar. My statements have been made advisedly and only after we have proven their accuracy in our laboratory. We are prepared to demonstrate, if you wish, the accuracy of these statements.

Mr. Fulweiler says that this specification will permit the use of 25% of water-gas-tar. I know his statement is correct and that he too has proven his case in his laboratory. Yet your Committee says that their specification is designed to permit only the use of products of coal-tar. They think the specification should be broad in its limits. That it should let in everything. Under those wide limits the City Engineer would not know what he is getting, whether coal-tar and creosote, or pure creosote, or a mixture of coal-tar, creosote and water-gas-tar, especially if he depends only upon safeguards of the specification itself.

MR. H. M. NEWTON: Mr. President.

THE PRESIDENT: Mr. Newton.

MR. A. E. LARKIN: I call for the question.

THE PRESIDENT: The question is called for.

MR. S. R. CHURCH: What is the question, Mr. President?

THE PRESIDENT: Let us get the motion. The motion is simply to refer this report of the Special Committee to Committee No. 1, the Committee on Preservatives, which will be appointed next year.

MR. J. C. WILLIAMS: That is referred as information only.

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THE PRESIDENT: Well, referred as information.

THE MEMBERS: Question, question.

THE PRESIDENT: You all understand it. If you vote Aye, or the majority vote Aye, you simply refer it as information. If you vote No, then we will take up the question whether you will adopt the report or not. Are you ready? Those of you in favor say Aye, opposed No. The Chair is in doubt.

MR. J. C. WILLIAMS: Mr. Chairman, I would ask the Secretary to call the roll of the Corporate and Honorary Members.

THE PRESIDENT: Can we not take a rising vote? I do not think anybody but Corporate and Honorary Members will vote, although your point is well taken.

MR. J. C. WILLIAMS: Mr. Chairman, there is hardly a member here that is individually acquainted with every man in the convention. We have a lot of Associate Members and visitors. I think it is proper that the roll shall be called.

THE PRESIDENT: Well, sir, I will have to accept the roll call. But there is not a man here that I would not trust to vote whether he was a Corporate or Honorary Member, (applause).

MR. E. B. FULKS: I agree with you that such a thing never has been done. The gentleman has, of course, a perfect right. There have been frequent calls for a standing vote. If we cannot trust people whom we invite to visit here not to vote we better not have any visitors, (applause).

THE PRESIDENT: I do not think the Chair is making an unjust ruling, and I think that you people have had your say and you have had a lot of oil men with you, and I would like to have you withdraw that, but if you will not we will call the roll.

MR. J. C. WILLIAMS: I will withdraw my request, Mr. President.

THE PRESIDENT: Thank you. Now, remember only Corporate and Honorary Members can vote. The two men who, as it has been said, are very much disinterested in this question are Mr. Fulweiler and Mr. Church. They cannot vote, because they are Associate Members, but they are the only two that I know of. Now, I want those in favor of this, the Corporate and Honorary Members, to stand on their feet. The Secretary will count them.

THE SECRETARY: Thirty-one.

THE PRESIDENT: Now, the Corporate and Honorary Members that are opposed to the question stand up.

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THE SECRETARY: Twenty-two.

THE PRESIDENT: The motion prevails, and the report is referred to the incoming Standing Committee on Preservatives.

WATER SAMPLING IN CREOSOTE OIL.*

During the past year the Committee on Wood Preservation of the A. R. E. A. has given further attention to the question of developing a standard method for determining the percentage of water contained in creosote oil when shipped in tank cars.

The sampling of liquids in tank cars is an exceedingly difficult matter; in fact, a Special Committee of the American Society for Testing Materials reported that it had been unable to find any method which could be recommended for obtaining satisfactory samples of liquids when shipped in tank cars. After much consideration, the Committee finally decided to carry on a series of tests with various methods for sampling. These tests were carried on under the auspices of the Committee with the co-operation of similar committees, at the request of the Chairman, of American Society for Testing Materials and the American Wood-Preservers' Association.

The Committee wishes at this point to express its acknowledgment for the very valuable assistance, in carrying on the tests and in preparing the report, of S. R. Church, of the Barrett Manufacturing Co. and of E. B. Fulks, of the American Tar Products Co.

Under the direct supervision of the Sampling Committee, two tank cars were loaded with creosote oil at the Shadyside, N. J., plant of the Barrett Manufacturing Co., Dec. 22, 1915, shipped to Federal Creosoting Co. plant at Rome, N. Y., and unloaded at that point on Jan. 3, 1916. Samples were taken by various means and afterwards divided into three sets. One set of samples was tested in the laboratory of von Schrenk and Kammerer, another in the laboratory of the Port Reading Creosoting Plant, and the third in the laboratory of the Barrett Manufacturing Co. This report comprises a description of the manner of loading and unloading the cars and sampling of same.

In accordance with the prearranged plan, one car was loaded with substantially dry oil, and a measured volume of water added to the car from a separate source, and the other car was loaded with oil containing about 7% of water. The two cars, GATX 4480 and APTX 52, each had a marked capacity of 8,043 gals., and inside shell diameter of 82 ins. Before loading, the cars were cleaned and the steam coils tested. The procedure was as follows:

GATX 4480: The oil was pumped from storage tank to car by the plant service pump, and a continuous drip sample taken in accordance with method described in report of Committee D-7, American Society for Testing Materials (A. R. E. A. Proceedings, 1915, page 625). Four hundred and fifty-two gallons of water were run in by gravity from a measuring drum having an exact capacity of 113 gals. The flow of water was timed so that it coincided with the flow of oil. The water entered through a 2-in. pipe directed so that the stream of water en-

*Extract from Bulletin No. 184, Feb. 1916, of the American Railway Engineering Association.

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tered and mingled with the stream of oil. The car was loaded so that the oil level was in the dome. Temperature of oil in car immediately after loading was 126° F. Samples were immediately taken at points 1 ft. from the top, at the center, and 1 ft. from the bottom of the car, as ordinarily practiced at this plant.

The sampling vessel, hereafter referred to as a bottle, consisted of a 1-quart metal can, weighted with lead, and stoppered with a cork, to which was attached a cord for withdrawing the stopper at any desired level.

One hour and 40 minutes after loading the car the temperature of the oil was 105° F. A sample was taken at the top of the car by a cross-section sampler, consisting of a glass tube 2 ft. long, closed by a valve at the bottom. (This type of sampler is used to a considerable extent in attempting to estimate the free water on the top of cars.) The tube showed 9 ins. of free water, of which 5 ins. was in the dome and 4 ins. in the car proper.

Zone samples were then taken from levels representing centers of 1 ft. zones from top to bottom of the car. For this purpose two devices were used, one being the bottle already described, and the other the Braun sampler. The latter consists of a small cylinder of about 200 cc. capacity, attached to a jointed tube having a total length of about 9 ft., with an inner tube operating a valve at the bottom of the cylinder, the outer tube acting as an escape pipe, so that when the sampler is opened air is released without disturbing the contents of the car. Owing to the small capacity of this device, it was necessary to take four samples at each level in order to obtain sufficient oil for testing, and it was noticed while transferring the oil from the sampler to the sample can that a considerable amount of water and oil, which adhered to the surface of the rod when the sample was withdrawn, ran down the rod and into the can during the discharge of the sample.

ATPX 52: The wet oil, which had previously been transferred from a storage tank to a tank car in order to be available when desired, was pumped into Car 52 by means of temporary pump and pipe line connection, and a continuous drip sample taken during the pumping. When the car was loaded the oil level was in the dome. The temperature of the oil immediately after loading was 130° F. Samples were then taken from top, center and bottom by the bottle method, as usual, but no further sampling of this car was done at Shadyside.

The cars arrived at Rome, N. Y., on Dec. 30. They were placed on the unloading track. At this plant the cars discharge by gravity into a tank directly below the track, the oil running from the tank car outlet into a large funnel.

The procedure at Rome was as follows:

No steam was placed in the coils of the cars until 7:30 a. m. on Jan. 3. At this time the oil had solidified in both cars. After 3 hours' heating, the contents of both cars were perfectly liquid.

GATX 4480: Temperature of oil in car was 122° F. The oil level in this car was exactly the same as at Shadyside, viz., 5 ins. of oil in the dome. The cross-section sample from top by the 2 ft. glass tube showed practically no separation between oil and water. One-foot zone samples were taken by a device similar in principle to the Braun sampler used at Shadyside, the latter having been discarded as inadequate. The construction of the sampler used at Rome is roughly indi-

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cated in Fig. 1. Samples were taken at top, center and bottom with the bottle sampler. The car was then sampled by the Federal Creosoting Co. in the manner ordinarily practiced at that plant, using a thief sampler, consisting of a tin cylinder about 2 ft. long, 3 ins. in diameter, with a 1 in. hole in the top. This was lowered quickly to the bottom, and raised slowly in such a way that it was not quite full when removed. The oil was then discharged from the car by gravity, and a dipper sample was taken from the open stream, taking about a pint of oil every five or six minutes. In this way about a two-gallon sample was collected, of which an average sample was finally taken.

ATPX 52: The procedure in sampling Car 52 was identical with that described for Car 4480. The temperature of oil was 117° F. Oil level was about ½-in. below the dome.

The following is a list of samples which were marked consecutively as taken at Shadyside and Rome, and the results of water determinations on these samples at the laboratories of von Schrenk and Kammerer, and the Barrett Manufacturing Co. Owing to an unfortunate delay in the delivery of samples to the Port Reading Creosoting Plant, the results of their tests are not available for inclusion in this report.

Samples 1-23, Shadyside; 24-51, Rome.		Per Cent. Water.	
No.	Description of Sample.	Barrett.	von Schrenk & Kammerer.
1.	Drawn from Storage Tank 45 before loading Car 4480	0.10	0.2
2.	Continuous drip sample taken while loading Car 4480	0.9	0.8
3.	Bottle sample from top of Car 4480	14.0	11.6
4.	Bottle sample from center of Car 4480	5.3	6.0
5.	Bottle sample from bottom of Car 4480	6.5	5.6
6.	Cross-section sample from top 2 ft. Car 4480	54.8	58.5
7.	One-foot zone samples by Braun sampler, Car 4480, sample 7 being the top and sample 13 the bottom	74.5	...
8.	"	8.0	...
9.	"	10.0	...
10.	"	6.5	...
11.	"	6.6	...
12.	"	9.8	...
13.	"	14.1	...
14.	Bottle zone sample Car 4480 (top)	37.1	37.9
15.	" " " " " "	3.5	4.9
16.	" " " " " "	2.0	2.1
17.	" " " " " "	1.9	2.2
18.	" " " " " "	2.5	1.9
19.	" " " " " (bottom)	6.4	7.4
20.	Continuous drip sample from loading Car 52	7.4	7.7
21.	Sample from top Car 52 (bottle sample)	6.1	5.8
22.	Sample from center Car 52 (bottle sample)	5.9	7.7
23.	Sample from bottom Car 52 (bottle sample)	12.0	13.6
24.	19-in. cross-section sample from Car 4480	79.0	...
25.	Cylinder 1-ft. zone sample, Car 4480	35.0	37.0
26.	" " " " " "	4.0	4.9
27.	" " " " " "	4.0	4.4
28.	" " " " " "	3.0	2.1
29.	" " " " " "	2.0	2.0
30.	" " " " " "	5.6	4.2
31.	" " " " " "	5.0	4.3
32.	Bottle sample from top of Car 4480	7.3	7.2
33.	Bottle sample from center of Car 4480	4.5	5.0
34.	Bottle sample from bottom of Car 4480	4.0	4.6
35.	Federal Creosoting Co. thief, Car 4480	12.6	15.0
36.	Dipper sample, Car 4480	15.0	19.5
37.	19-in. cross-section sample, Car 52	13.7	...

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Samples 1-23, Shadyside; 24-51, Rome. No.	Description of Sample.	Per Cent. Water. Barrett.	von Schrenk & Kammerer.
38.	Cylinder foot zone sample Car 52 (top).....	7.5	7.5
39.	" " " " " " "	8.1	8.0
40.	" " " " " " "	8.8	8.0
41.	" " " " " " "	8.0	7.2
42.	" " " " " " "	8.0	8.1
43.	" " " " " " "	9.0	7.4
44.	" " " " " " (bottom).....	10.8	10.2
45.	Bottle sample from Car 52, top.....	8.0	7.7
46.	" " " " " center.....	8.0	8.1
47.	" " " " " bottom	9.5	8.9
48.	Federal Creosoting Co. thief, Car 52.....	7.9	8.5
49.	" " " " " "	9.3	7.4
50.	Dipper sample, Car 52.....	8.0	8.7
51.	" " " "	8.0	9.7

In order to present the results in graphic form a drawing is appended*, showing vertical cross-sections through each car. On this drawing we have indicated the points at which various samples were taken, the device by which they were taken and the results of the water test. On this drawing the results are those obtained in the Barrett Manufacturing Company's Laboratory.

It will be noted that the figures given for water found for the different zone samples are calculated according to factors found on the drawing appended to this report. The actual percentage of water found in any zone does not correctly represent the real percentage, because the number of gallons found in the different zones differ because of the shape of the tank car. The percentage of water found in each zone should be multiplied by the figure at the right-hand side of the table representing the relation of this zone to the entire car. In other words, take the diameter of the car, as shown by the figures at the base of the diagram, run up on the vertical line to the zone line, and where this point crosses the horizontal line note the figure at the left-hand side of the table, which will express the percentage relation. The sum of the results obtained for this calculation for the samples from the different zones represents the total percentage of water in the car.

It will be noted that the results obtained by the various methods of sampling from Car 4480, which contained dry oil to which water was deliberately added, varied widely, but on the other hand, the tests on wet oil contained in Car 52 are quite uniform. The Committee observed that the water separated rapidly from the oil in Car 4480, so that indeed there was more free water on the surface of the oil within two hours after loading than there was at the time of unloading. Evidently the water and oil had become mixed during transit and the water did not again separate so rapidly from the oil. With Car 52, on the other hand, there was no apparent separation of water and oil, even though this oil contained more water than the other. It is obvious, of course, that the partial separation of oil and water, such as took place in Car 4480, makes sampling more difficult than when the water is uniformly distributed throughout the oil.

CONCLUSIONS.

The tests described above and the results obtained are presented as a progress report. The following preliminary conclusions have been drawn by the Committee.

1. That for accurate determination of water in a tank car of

*See A. R. E. A. Bulletin 184.

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creosote, a system of sampling from several zones in a car is necessary. These zones must represent definitely calculated areas throughout the entire depth of the car. There must be at least three zones, the top, the middle and the bottom of the car. The indications are that for the most definite determination zones 1 ft. deep are to be preferred.

2. That for calculating any percentage of water found in any zone in relation to the proportion to the entire car, the correction factor indicated on diagram be used.

3. That the cross-section tube frequently used for taking samples from tank cars is of little value. It disregards the fundamental principle of zone sampling, in that it takes no account of the proportionate value of the sample taken with reference to the whole car. It, furthermore, cannot be used in connection with zone sampling without much additional computation.

4. The so-called thief (1915 Proceedings, American Railway Engineering Association, Vol. 16, page 831) has been found incorrect in theory, and the results obtained therewith confirm this.

5. That the taking of a dipper or bucket sample from the running stream of cars while discharging does not give reliable results, and that this method should not be used.

6. That the bottle method, meaning the use of a small stoppered vessel from which the cork can be withdrawn at any desired level, is a convenient apparatus for taking zone samples. Its disadvantage lies in the fact that escaping air, after the withdrawal of the cork, tends to disturb the surrounding oil, and therefore gives an incorrect sample.

7. That for the present an apparatus, the principle of which is shown in Fig. 1, be used for zone sampling in taking samples from cars in which a high percentage of water is suspected. It should be understood that the appended sketch is merely to show the general plan of the sampler.

8. That efforts be made to construct an improved form of the sampler just referred to, provided further tests warrant a definite recommendation for its use.

9. That for ordinary purposes the taking of three zone samples, that is, from the top, the middle and the bottom of a car, by means of the apparatus just referred to or by means of a bottle device, is recommended.

10. That the tests described this year be considered preliminary and that similar tests be made at various treating plants and tar plants during the coming year. Care should be taken to make such tests to include both summer and winter shipments.

THE PRESIDENT: Gentlemen, shall we continue right along or shall we adjourn for lunch? Our good looking young man who has provided all the entertainments wants to make a speech.

Mr. A. R. Joyce, Chairman of the Entertainment Committee, then made further announcement concerning the entertainment for the members of the Association and the visiting ladies.

THE PRESIDENT: We will now stand adjourned till 2 o'clock.

The meeting then adjourned till 2 o'clock P. M., January 19.

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WEDNESDAY AFTERNOON SESSION

The meeting was called to order by President Waterman at 2 o'clock P. M.

THE PRESIDENT: The Secretary has a message from London. You see, if they are excited over there they still know the American Wood-Preservers' Association is on earth.

THE SECRETARY: A telegram from Felix Berk:

> Greetings to you and fellow members. Best wishes for fruitful meeting.

Mr. Berk is a chemical manufacturer, of F. W. Berk & Company, London, England.

THE PRESIDENT: Mr. Sterling is Chairman of Committee No. 2. Mr. Crawford, Mr. Winslow, Mr. Fisher, Mr. Smith, Mr. Rex, Mr. Card, and Mr. Goss are members of that committee. Mr. Sterling will come forward and make his report.

MR. E. A. STERLING: Mr. President and gentlemen: It will take only a moment to explain the character and scope of the report of Committee No. 2. It is essentially a revision and a rewriting of last year's report. It covers, as you know, a very broad subject, and I think the intent from the beginning has been to accumulate all of the available information under this subject, adding and changing, and then as time went on to pick out from that information such parts as may be put in the form of specifications. In other words, we are working towards a standardized practice, which means specifications as far as we are sure of them.

I feel, Mr. President, that it will not be at all necessary to read this report, but I will run through it and hit a few of the high spots and leave it in your hands.

On the first page we followed last year's outline which we understand accords with the instructions of the Executive Committee. This falls under five main headings, with subdivisions of the last. Turning to the second page, under A, the Purchase of Treatable Woods, I want to say that the Committee is very much indebted, and I think the Association is too, to Mr. Winslow of the Forest Products Laboratory for his very careful sub-committee report and revision of this whole subject. This is the part of the report which has been most radically changed. I do not have the original here with the changes which have been made, but I hardly think it is necessary to go into that in much detail. This part on the purchase of treatable wood is now in much better shape than last year, and I will simply pass over it for your later consideration.

On pages 3 and 4 there are a few eliminations, due to the fact that

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at the last minute we decided to leave out an appendix, and in the hasty work which the Secretary knows went on to get this in print we simply neglected to mark out some of the paragraphs and sentences referring to the appendix.

Starting at the bottom of page 3, middle of the last line, "For example, average Western" and continuing on page 4 to the end of that paragraph "white cedar," we eliminate. Paragraph B, page 4, leave out the word "since," the third line from the bottom on the left-hand side, Paragraph B, also eliminate from the word "subject" next to the last line, that is, eliminate "a tentative grouping is given in the appendix." There is no appendix, so that naturally goes out.

Under the heading B, Preparing Timber for Treatment, there have been only minor changes made.

Under C, Specifications for Preservatives and General Method of Application, Mr. Rex in charge of the sub-committee on that heading has worked up and we have embodied certain specifications under the respective headings as you find them, such as "Full-Cell Treatment," and so forth. Those are new features of this paper.

Beginning on page 10 and continuing over on to page 11 and still under the subheading C, Mr. J. B. Card and the Chairman entirely revised No. 2 and No. 3 under the subjects "Chloride of Zinc" and "Creosote-Zinc Chloride." So you will find that those are quite different from last year.

On page 12 the Summary of Preservatives and Treatments has been added. This is merely intended to sum up what precedes, and to bring particularly to the man who is not thoroughly familiar with the treating business some of the essential facts relating to the different processes and preservatives.

Under D, Summary of Fundamental Principles, we made a few minor changes permitting, at the request of the West Coast people, higher temperatures for Douglas fir than were allowed last year.

On page 13, paragraph E, Regional Considerations, we drop last year's discussion. I think, however, it is still the feeling of the Committee that this matter should be taken up. It is a very large and very difficult question when you come to tie up preservatives and methods of injection and the various other factors according to regions, which means that you have to take in transportation, cost of material and all that sort of thing. It was too big a subject to go into again this year, and we simply eliminated last year's portion of it, because it was a repetition. With these few remarks, Mr. President, I will leave the report to the kind mercies of the convention. I do not know whether it is proper for the Chairman to recommend its adoption, or not.

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THE PRESIDENT: It is proper for the Chairman to recommend anything he wants to.

MR. E. A. STERLING: I only know that is the practice in the American Railway Engineering Association, for the committee to turn its report over with a recommendation for its adoption, but I will do whatever you say.

REPORT OF COMMITTEE ON SPECIFICATIONS FOR THE PURCHASE AND PRESERVATION OF TREATABLE TIMBER.

To the Members of the American Wood-Preservers' Association:

The work of Standing Committee No. 2 for 1915, has been to revise last year's report and add such new subject matter as has been made available. The species and character of timber for treatment, the kind of preservative and general methods of application, with a review of treating methods and a statement of fundamental principles, cover the broad field suggested by the subject assigned. To summarize into specifications, as far as possible, is the ultimate end.

The following general outline, we believe, accords with the instructions of the Executive Committee, and covers the fundamentals under the subject heading of Committee No. 2:

A. The purchase of treatable woods, with sub-heads according to uses and service requirements.

B. Preparing timber for treatment, with special reference to seasoning.

C. Selection of preservatives and general methods of application, in accordance with the kinds of wood, preparation for treatment and uses.

D. Fundamental principles underlying efficient treatment of any kind, with specifications for generally accepted procedure.

E. Discussion of regional considerations based on

Region I.—Abundant Timber and Warm, Moist Climate.
The Gulf Region, Lower Mississippi Valley and Atlantic Coastal Plain, south of where severe winter conditions prevail.

Region II.—Abundant Timber and Dry Climate.
The timber region in Arizona and New Mexico, and northward along the eastern slopes of the Rocky, Sierra Nevada and Cascade Mountains.

Region III.—The Moist Central Hardwood and Northern Mixed Forest.
The hardwood belt of the Central States and Mississippi Valley, and the mixed conifers and hardwoods of the Lake, Middle and New England States.

Region IV.—The Moist Heavily Timbered Sections of the Pacific Coast.

Region V.—Treeless Plains, and Prairies.
Ranging from arid to semi-humid.

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A—The Purchase of Treatable Woods.

This topic is the logical first consideration, since upon the kind and character of the timber purchased largely depends the method of treatment and the ultimate value of the material. For the present this topic is limited to structural timber, track ties, and piling. Paving blocks are under consideration by Committee No. 3, while poles, posts, mine timbers and other classes of material are left for later consideration.

(1) *Structurral Timbers.*

The fundamental requirements of structural timbers for treatment are strength and capacity for treatment to an extent which will insure protection against decay on all exposed surfaces. A penetration of ½ in. on the heart faces may be recommended as a safe minimum on structures above ground, although with a few resistant woods as good a treatment as can be expected will show less than ½ in. penetration in the heart.

The strength requirement is determined by the species, and is further dependent upon the soundness, density of the wood, frequency, size and location of the knots, the extent, character and location of shakes and checks, and the character of the grain. Treatability in most woods is determined by the proportion and relation of heartwood and sapwood, with exceptions in the case of heartwood which takes treatment. Where strength is required, not only the defects which might reduce the strength but also the quality as determined by density should be specified; but where strength is not an essential only the soundness of the timber and the sapwood requirements as determining penetrability need be considered.

With the foregoing in mind, the Committee recommends the adoption of the following:

a. Restrictions on knots, shakes, checks, and cross grain.—Adopt the specifications which have been adopted during the year by the Southern Pine Association. These specifications should apply to all structural timbers where strength is pre-requisite.

b. Restrictions on density and rate of growth.—Southern yellow pine.

Adopt the specifications which have been adopted during the year by the Southern Pine Association and which have been recommended by the committee on specifications for timber of the American Society of Testing Materials, and used in the building code of the National Board of Fire Underwriters. These specifications apply to all Southern pine structural timbers where strength is pre-requisite.

It is not possible at the present time to recommend similar density and rate of growth specifications for other species. It is recommended, however, that the Committee be instructed to further consider this matter, giving first attention to Douglas fir.

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c. Sapwood restrictions.—Since, for a given species, sapwood of equal moisture content and density, (see explanation in Yellow Pine Grading Rules) is as strong as heartwood, sapwood restrictions need only be considered in relation to the efficiency of treatment. With red oaks, hemlocks, and spruces, for reasons brought out under the discussion on "ties," no consideration need be given to sapwood restrictions. With the pines and Douglas fir, however, the amount and distribution of sapwood is of much importance. The following classes listed in the order of their suitability for treatment cover restrictions of this nature:

1. Timbers showing no heart on any face.
2. Timbers showing no sap on any face.
3. Heart face timbers with not less than 80% heartwood.
4. Heart face timbers with not over 20% heartwood.
5. Other timbers not falling in any of the foregoing classes.

d. Other restrictions.—For other restrictions not covered in the foregoing, it is recommended that the specifications of the American Railway Engineering Association, as given on pages 141-144, inclusive, of the 1911 edition of its Manual, be adopted.

(2) *Track Ties.*

Under this heading are included standard cross ties, bridge ties and switch sets. The latter two are included under this head, because the specifications are practically the same as for track ties, although usually purchased by board feet instead of by the piece.

While the variety of species used for ties and the varied conditions of service to which they are subjected render it impracticable to propose specific specifications to cover each and every case, yet it must be recognized that the fundamental considerations are the strength or mechanical properties and the relative ease or capacity for treatment. It is felt that systematic information on these two points should be developed for the benefit of those engaged in both the production and consumption of ties. This would be an important line of investigation for next year's work.

a. Mechanical properties.—Since sapwood of like density and moisture content to heartwood, is also of like strength the relative proportion of sap and heart on the same species may be considered from this standpoint.

While the mechanical properties of ties as with structural timbers are dependent upon the density of the wood, it seems neither practicable nor advisable at this time to propose density restrictions for tie specifications.

A further consideration is in regard to the effect of decay on the strength. Decay even when not very noticeable, may greatly reduce the strength value, and hence, with species which decay rapidly, but short service in the track may result in a decided weakening.

b. Capacity for treatment.—Since it can be generally stated that, with but few exceptions, the sapwood of all species is

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fairly easy to impregnate, while the heartwood is difficult, the relative proportion of heart and sap is of prime importance. A proper grouping on this basis is very desirable, but the Committee is not ready to recommend definitely on this.

c. Other factors.—Aside from the foregoing restrictions and classifications regarding strength and sapwood restrictions, the specifications as to defects, size, etc., as adopted by the American Railway Engineering Association are recommended.

(4) *Piles*

The selection and purchase of piles for treatment should take into consideration their ultimate use, whether in salt or fresh water, for land foundation or marine work, and particularly whether subject to marine borers. The sapwood requirements, especially when the heartwood is resistant to treatment, should be based directly on service considerations. The following sapwood restrictions are based on classification of the character of service for which the pile is to be used:

1. Piles for use in salt water where ravages of marine borers are extremely severe. Specify not less than 2½ in. of sapwood, nor more than 5 in.
2. Piles for use in salt water where ravages of marine borers are less severe than in Group 1. Specify not less than 1 in. sapwood, nor more than 3 in.
3. Piles for use in fresh water or foundation work on land. No sapwood restrictions are necessary.

For the present the specifications of the American Railway Engineering Association (1911 Manual, pages 145-146) may be followed as to dimensions and defects of piling.

B—Preparing Timber for Treatment.

Preparing timber for treatment embodies mainly the various steps in the seasoning process, and is a very important factor in determining the ultimate value of the treated material. Owing to the wide diversity of conditions and the individual characteristics of the different woods, it is difficult to specify definitely under this headng. There are, however, certain fundamental principles which may be stated without further investigations.

Whenever conditions will permit, thoroughly air season all structural timber, track ties, piles and other material before treatment. So far as practical arrange delivery of material so that the seasoning period may be during seasons of minimum rainfall and humidity. Pile incoming material in its proper groups or classes, separating green from seasoned or partially seasoned material, and using successive portions of the yard for the storing of green timber.

The seasoning yard should be in the open where the prevailing winds will strike it freely; should not be near any large bodies of

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water, nor in a low and humid situation of any kind if it can be avoided; should have good drainage; and should be kept free from weeds and grass and decaying wood material.

All outer bark should be removed before treatment and in most cases before seasoning. Also as much of the inner bark should be removed as practical, and in no case should over 10% or strips over 1 in. wide and 6 ins. long be left.

Adjust the methods of piling ties and timber for seasoning to the local climatic conditions, so as to obtain maximum rapidity in seasoning without undue checking or warping. Wooden stringers on which piles are supported should be treated. Support all piles on treated stringers and in all cases at least 6 ins. of air space allowed underneath. The alleys between the piles should be not less than 5 ft. in the working spaces and 1 ft. in other directions.

In a moist climate and under humid conditions, season all material in open piles, which will provide free circulation of air and exposure to the sun. Place a close slanting roof of ties over all piles. By open piles is meant the common 1x7, 1x8, or 7x2 piling system, or other arrangement which gives a minimum contact and the maximum of open space between the ties. In arid climates with low humidity, season in close piles to prevent checking and warping.

Practically all woods can be air seasoned except in low, humid locations. Gum is an exception unless air seasoned under favorable conditions. Both gum and beech should be seasoned only in wide open piles and watched very carefully for dry rot. "Bluing" of sap pine during seasoning is not necessarily an indication of decay.

Ties and timber which have a tendency to check should be protected with "S" irons, or other devices. These should be applied in the seasoning yard to all sticks showing serious initial checks in order to prevent further checking during or after treatment. Red oak and beech should be watched closely in this regard.

Hardwood track ties should be given a minimum of 8 months' seasoning, and should preferably be seasoned 12 months; yellow pine if seasoned in the South, 4 to 6 months; hemlock, tamarack, and jack pine 12 months. Over seasoning may prove detrimental with some species.

A determination of whether wood is sufficiently air seasoned for efficient treatment may be based on moisture extraction from borings which should show an average of not over 30% moisture in relation to the oven dry weight of the wood; or, if the above moisture determinations cannot be made, season to a constant weight. Consideration may be given to a new Troemroid Scalometer device for determining the moisture content of wood. In some cases it is advisable to make local

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experiments to determine the weights at which timber treats best. (See Bulletin 161, American Railway Engineering Association on "Air Seasoning of Timber.")

When there is not sufficient time for proper air seasoning, or, in the case of piling and large dimension timbers which will not air season successfully throughout without deterioration, artificial seasoning by steaming or boiling before treatment must be resorted to. In steaming the pressure should at no time exceed 20 lbs. per square inch, nor the oil temperature in boiling exceed 200° F. with possible exceptions in the case of some Pacific Coast timbers which may require higher temperatures.

Insist on prompt delivery of all material to the seasoning yard, and on open piles while in the woods or on the right-of-way, the closest piling permissible being 7x2. Gum should not be left in the woods nor in close piles over 10 days; treatable hardwoods and sap pine not over 30 days, and heart pine not over 60 days.

Douglas fir offers a special problem in seasoning. It is urged that a further study of seasoning methods and their effect on strength and penetration be made. The recent methods of seasoning and treatment, without material reduction in strength of Douglas fir, developed by the Association of Pacific Coast Creosoting Companies should be investigated and according to present indications used in preference to the old boiling or steaming process.

C—Specifications for Preservatives and General Methods of Application.

This subject has been presented and discussed by various engineering associations, and further investigations are under way. The Committee, therefore, does not consider it expedient to suggest changes or modifications of existing specifications for preservatives or processes at the present time. There is, however, immediate need for information and recommendations covering the choice of preservatives, and of treatment in relation to the kinds of wood and its uses. This subject is complicated by the necessity of considering regional conditions, service, location of treated material, and plant location. It is not possible for the Committee to fully cover this ground at present, and the suggestions which appear in this report should be considered preliminary to further investigations.

Since the 1911 Manual of the American Railway Engineering Association, pages 446 to 450, gives detailed specifications of processes, a review of these treatments here would be largely repetition. The following presentation of preliminary recommendations for recognized primary preservatives is in relation to the important question of treatment as influenced by service requirements.

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(1) *Coal Tar Creosote.*

From the standpoint of permanence and protection of wood against decay and marine borers, coal tar creosote is the best available preservative for general purposes. It possesses the necessary theoretical requirements, and has stood all practical tests through many years' use under varying conditions of service and in many different kinds of material.

While the carefully drawn specifications of the American Railway Engineering Association and other organizations are desirable and should be followed wherever cost and availability permit, there is no proof that the higher grade creosote oils are necessary when timber is treated to refusal or practically so. The attainment of a high standard and the insistance upon specified fractionation, is the surest protection which the consumer can have in procuring the best quality of oil available. The question of availability and economy, however, often necessitates a modification of the strictest requirements, and at the risk of trespassing on the province of Committee No. 1, the Committee suggests under existing conditions the acceptance of Grades 2 and 3 as specified by the American Railway Engineering Association, for all general purposes for which Grade 1 oil was demanded when available. It naturally follows that the less the injection the better should be the quality of the creosote, from which it is evident that the heavy, high boiling creosotes represented by the German product are preferable for empty cell treatment.

Economical considerations are quite apart from the general acceptance of creosote as the most effective preservative. This leads to methods of reducing the first cost of treatment, and we, therefore, have two general methods of applying creosote to timber as follows:

Full Cell Treatment.

This form of treatment under the name of the "Bethel" process, has been used extensively for years. It is essentially the impregnation of wood with practically all of the creosote it will hold, thereby giving the maximum protection. For many purposes this treatment is too expensive, and, we, therefore, make the following recommendations for its use:

The Committee recommends the use of the full cell process for piling and other marine timbers where subject to attack of the teredo and other marine borers, and that in such situations an injection of at least 20 lbs. per cubic foot, or treatment to practical refusal, should be given; while in marine and land situations where decay is the principal source of failure, treatments may range down from 20 to 10 lbs. per cubic foot by the same process, the injection in all cases to be sufficient to penetrate all the sapwood.

We further recommend the full cell treatment in perma-

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nent structures not subject to mechanical wear; when conditions of moisture, climate or humidity are favorable to wood destroying fungi, and particularly where the cost of renewals or replacement would be high.

To the end that the best practice may be standardized we offer the following as a specification:

SPECIFICATION NO. 1.—FULL CELL TREATMENT OF TIMBER.

1. *Seasoning.*—Where conditions permit, all ties shall be thoroughly air seasoned; the state of seasoning to be determined by moisture content determinations. Practicable moisture content limits for localities and timbers, should be established by experiments.

If, for any reason it is impossible to obtain air seasoned material, artificial seasoning may be used in accordance with practices, as hereinafter specified.

2. *Seasoning by Steam.*—The tie shall be placed in the cylinder and live steam introduced through pipes insuring proper circulation, care being taken to relieve cylinder of dead air before pressure is raised. The pressure is then gradually raised to 20 lbs., with its corresponding temperature of 258° F. and maintained for such a period as is deemed necessary to properly prepare the timber for the reception of the oil. During the cleaning period, the cylinder shall be kept free from condensation by bleeders properly located.

3. *Vacuum.*—At the expiration of the steaming period the steam shall be blown from the cylinder and a vacuum created of not less than 24 ins. and maintained above this point for two hours. Steam coils to be run at maximum during vacuum period.

4. *Filling of Cylinder With Preservative.*—Means shall be provided by which cylinder shall be thoroughly drained of all condensation at the end of the vacuum period, without breaking vacuum.

The oil shall then be introduced into the cylinder, under vacuum, at such a rate as to permit vacuum pump to maintain a partial vacuum until filling is complete.

The temperature of the oil at time of introduction into cylinder shall be between 170° F. and 190° F., and shall be maintained between these limits during pressure period.

5. *Pressure.*—The temperature, and intensity, and duration of pressure shall be maintained in such a manner as to secure the greatest possible distribution of penetration, with the specified amount of the preservative.

At the expiration of pressure period, the cylinder shall be drained and charge left in cylinder for sufficient time to prevent the loss of preservative from bleeding. If desired, this period may be shortened by final vacuum.

6. *Thermometers and Gauges.*—All tanks and cylinders shall be equipped with thermometers and gauges so located as to accurately reflect the conditions during the treatment and the quality of preservative retained by timber.

Proper allowance for expansion and contraction of preservatives shall be made to determine net quantity used.

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7. *Marine Treatment.*—Marine treatment requires a much greater retention of oil and depth of penetration than material not subjected to the action of sea life; therefore, in order to secure this, the timber must be subjected to greater preliminary artificial seasoning than that described under full cell treatment.

Empty Cell Treatment.

Empty cell treatment with creosote aims to reduce materially the final retention of creosote per cubic foot, giving at the same time equal depth of penetration.

The two recognized empty cell processes base their patent features on fundamentally different means of attaining the same end. One of these requires an initial air pressure which is held during the introduction of the creosote, and the application of the pressure necessary to force it into the wood. When the oil is withdrawn from the treating cylinders and the pressure reduced to sub-normal by a vacuum, the initial air in the wood forces out the surplus creosote. With the other process, a quick high final vacuum is depended upon to recover the surplus oil. By each of these processes a maximum depth of penetration with a final retention of 5 to 8 lbs. of oil per cubic foot is claimed. With some species even smaller quantities of oil may be fully distributed.

With the increased cost of creosote and a shortage in supply, and the growing realization that it is entirely useless to preserve timber from decay beyond its mechanical life, empty cell treatments have rapidly grown in favor and are used by several of the largest railroad systems. While definite deductions may be drawn from theoretical consideration of the two processes and divergent opinions are held, it is not for the Committee to pass judgment, and the fact remains that both processes have received wide recognition.

The essential factor entitling any empty cell process to recognition or approval is that there be an appreciable recovery, usually a minimum of 40% of the oil injected, and that initial penetration before recovery of the surplus be entirely through the treatable portions of the stick; that is, through the sapwood and at least superficially in the heartwood, the extent of the latter depending on the species. It should be remembered that an average of 5 lb. per cubic foot may mean a retention of 8 to 10 lbs. per cubic foot in the treatable portions where most needed.

The Committee finds the empty cell treatment suitable for all pine and other easily treated track ties used in moist climates, under service conditions which give a mechanical life in keeping with the anticipated life for decay; also for structures of limited life or subject to superficial mechanical wear, and elevated so as to be exposed mainly to the wood destroying influence of weather conditions.

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In all outside situations it is recommended that a maximum injection of creosote, or sufficient to insure the penetration of all treatable wood, be required, and that not less than an average of 5 lbs. of creosote per cubic foot be left in the treatable portions of the wood; while it is urged as a definitely specified requirement, that at least all of the sapwood and as much of the heartwood as is possible for the particular species shall be thoroughly impregnated, and the depth or extent of the penetration be equal to that of the full cell treatment.

The following specification for empty cell treatment is submitted:

SPECIFICATION No. 2.— EMPTY CELL TREATMENT OF TIMBER.

Seasoning.

Paragraphs 1, 2 and 3 same as in Specification No. 1.

3-A.—*Preliminary Air Pressure.*

Where preliminary air pressure is used from 50 to 110 lbs. air pressure shall be produced, and maintained in cylinder for at least 30 minutes. The intensity and duration of this pressure shall be governed by the character of timber being treated.

4. *Filling of Cylinder With Preservatives.*

The maximum air pressure shall be maintained during the filling of the cylinder with preservatives.

5. *Pressure.*

Same as Specification No. 1.

5-A. *Final Vacuum.*

In applying final vacuum where the recovery of oil is dependent on vacuum, it is essential to drain cylinder quickly and create a maximum vacuum in a minimum time.

Where final vacuum only to assist initial air pressure in recovery of oil and drying timber, the intensity and rapidity of vacuum is not essential.

6. *Thermometers and Gauges.*

Same as Specification No. 1.

(2.) *Chloride of Zinc.*

Chloride of zinc is of great importance as a preservative, and is the only mineral salt extensively used for wood preservation. It deserves full consideration in regions of low precipitation, in dry situations, and where low first cost is essential. It came into use in this country even before creosote, and has in most cases given service which fully justifies its application. While the life of zinc treated material is usually less than that of creosoted, the expense is also less, and the relation of cost to service is an important consideration. Further considerations are an ample domestic supply and ease of transportation. The efficiency of the zinc treatment depends largely on its proper application, and its use under suitable conditions. Our recommendations regarding zinc chloride are as follows:

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We recommend that where zinc chloride alone is used it be by the standard processes known as "Burnettizing" and that a full impregnation which will insure the retention of a minimum of ½ lb. of dry salt per cubic foot of timber be given. In stating the above minimum standard practice is followed, but the Committee suggests that under usual conditions a ¼ lb. injection would be advisable.

We suggest zinc chloride treatment in arid and semi-arid regions, particularly for track ties and other material with mechanical life limited to the expectation of life from decay and checking; also for woods resistent to creosote. It should not be used where mechanical wear is eliminated, nor in situations where the treated timber is in permanent or intermittent contact with either stagnant or flowing water. Consideration should also be given to its use on overhead trestles and similar structures.

Under usual conditions three months' seasoning after treatment is advisable.

Since there are conflicting data regarding the leeching of zinc chloride from timber, and since reliable statistics regarding its value in moist climates are not available, we would strongly recommend that definite service tests be made by the Association in the Southern and Eastern States to determine the actual life of zinc treated material in humid conditions.

(3) *Creosote-Zinc Chloride.*

The use of creosote and zinc chloride in mixture has been practiced for some years, both in this country and in Europe, although the Rutger process is now practically abandoned abroad in favor of straight creosote treatment. The most widely recognized use of this combination in America is by a process whereby the creosote and zinc chloride, since they are of different specific gravity, are emulsified during treatment by being passed through a centrifugal pump. A two-movement application of the two preservatives has also been used to a limited extent. In both cases the procedure is based on mechanical methods, and not upon a process of injection.

While evidence is at hand to indicate satisfactory service from timber treated by a combination of zinc chloride and creosote, the question has arisen as to the conditions under which the best results in economy and service will be obtained by proper treatment with straight zinc chloride, creosote-zinc chloride, or by a light empty cell treatment with creosote. In the absence of conclusive data the effect of creosoting as a seal, and of the coating or penetrative action of emulsified oil should be further investigated. The action of creosote in preventing checking within reasonable limits is recognized, but its waterproofing influence should be further investigated. The creosote-zinc chloride mixture is fundamentally effective, because composed of the two most widely accepted preservatives. In situations where the mixture or emulsion is preferable to a single preservative, it should be used ac-

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cording to the judgment of the consumer as to its greater economy and efficiency under the local conditions.

There is another subject on which experiments and service tests should be made, with the specific aim of determining the value of the combination in comparison with the same amount of either preservative alone.

The following specifications are suggested:

SPECIFICATION No. 3—ZINC-CREOSOTE TREATMENT OF TIMBER.

Seasoning.

Paragraphs 1, 2, 3 and 4 same as in Specification No. 1.

5. *Pressure.*

Same as Specification No. 1 with the addition that the preservative shall be constantly agitated during pressure period and thus prevent the separation of the two preservatives.

6. *Thermometers and Gauges.*

Same as Specification No. 1.

(4) *Coal Tar-Creosote Mixture.*

The Committee would refer to the 1913 report and recommendations of the American Railway Engineering Association on this subject. (Bulletin 163). The use of refined coal-tar under the restrictions specified by the American Railway Engineering Association (page 627, Bulletin 163) according to this report, does not appear to reduce the efficiency of treatment, and is particularly advisable under present conditions in order to conserve the supply of creosote. The next step is a specification for this solution. Refined coal-tar in quantities not exceeding 25% should, according to the same authority, not be considered an adulterant of creosote.

Summary of Preservatives and Treatments.

The foregoing discussion is intended to convey the definite impression that any one of the preservatives or processes in general use by the railroads of the United States will give service fully in keeping with the cost.

There are certain recognized conditions which have been pointed out. For example, a heavy full cell creosote process is the only known protection against marine borers, and no other treatment would be advised under such conditions. From this extreme at one end, we have the conditions in parts of the West where aridity or low precipitation, and remoteness from producing or shipping centers, unquestionably make zinc chloride the most economical preservative, although it should always be recognized that economy in annual charge does not necessarily mean extremely long resistance to decay. Between these extremes are very variable conditions of moistures, different character of

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structures, factors of mechanical abrasion, and a great many considerations which should influence the selection of the preservative or process to be used. Within this wide range, the creosote-zinc chloride and the empty cell creosote treatments fit in, the actual selection necessarily being based on the requirements of the individual consumer or company. The fact that the large railroad systems in some cases have adopted one process and in other cases another indicates, first of all, that the selected treatment has been found to be effective, and the point is rapidly being reached where the available service tests will indicate the relative advantages of economy of the different treatments.

Until more definite conclusions are reached on the basis of service records, it is entirely safe for the railroad or consumer to use any of the above standard treatments, if based on the best judgment under the circumstances.

D—Summary of Fundamental Principles.

The wood-preserving industry has so many ramifications, including lumbering, wood technology, chemistry, engineering, administrative and economic, that a statement of fundamentals covers a very broad field. Many points which may be considered fundamental have been discussed in other parts of the report; hence, the following will be limited mainly to additional discussions or recommendations:

Preservative treatment should be limited to kinds of wood which are not in themselves resistant to decay, thus making use of timber which otherwise would be unserviceable, and which is obtainable at low cost as compared with durable species.

The wood accepted for treatment should be of such a character as to be treated at least throughout the sapwood, and if the heartwood is not capable of treatment, it should be in itself resistant to decay.

Only sound timber, free from defects which would reduce its value for the purposes to be used, should be treated. Treatment will not cure decay nor defects of any kind.

The moisture content of the wood before treatment should be reduced, preferably by air seasoning, to not more than 30% of its oven dry weight, or to a constant weight basis.

The temperature in the treating cylinder cannot safely be raised above 260° F. in steaming, nor above 200° F. during oil immersion. In the vacuum boiling process the oil temperature may be increased to 212° F. or without a vacuum to a somewhat higher temperature if necessary to get penetration. It should be understood, however, that these higher temperatures reduce the strength of the timber.

The minimum duration of treatment, except with easily penetrated woods, should be equivalent to one hour for every radial inch on the

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sticks treated. Otherwise treatment will not be thorough or complete in the cool inside portions of a stick.

Wherever possible, all timber should be framed before treatment, and in lieu of this unimpregnated wood exposed by framing after treatment should be thoroughly painted with hot creosote oil.

To insure uniform bearing surface and maximum penetration under the rail seat, all ties should be bored and adzed before treatment. Although sawn ties may have a uniform surface, the boring increases the penetration at the point it is most needed.

Base efficiency of treatment primarily on the extent of distribution of a stated amount of preservative, rather than on final retention per cubic foot. At railroad plants and for railroad material, the recommendations of the American Railway Engineering Association (page 631, Bulletin 163) may be followed:

> It is therefore recommended that at railroad plants the absorption be based on the treatment which will give the most complete penetration for each kind or class of timber, specifying complete penetration of the sapwood and as much of the heart as is possible for the particular species or charge; payment to be based on the amount of preservative used, plus operating and other charges.

In specifying the amount of creosote to be injected, use gallon as the unit for track ties, posts, and other material of uniform size, and pounds per cubic foot for piles, poles and similar material of variable size, (page 631, Bulletin 163 of the A. R. E. Assoc.)

Adjust the treatment, including preservative and process, as far as possible to the mechanical life and service requirements of the material.

E—Regional Considerations.

Definite recommendations for the combination or specific application of "A," "B," "C" and "D," under regional conditions must be deferred until further data are compiled. The brief general discussion submitted last year has not been revised or modified, hence its inclusion here would be useless repetition.

RECOMMENDATIONS FOR COMMITTEE WORK IN 1916.

The Committee recommends the further elaboration of stated fundamentals, the compilation of new material where available, and the reduction of standard practice to specifications wherever possible. The specific recommendations would be largely for a continuation of the work along the lines outlined last year, as follows:

1. Continue independent work and co-operation with other committees in preparing detailed specifications of timber for treatment.
2. Investigation of the sources of supply and available quantity of treatable timber in relation to its assembling and distribution.

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3. Study of regional conditions as influencing availability of timber, cost of preservatives, and methods of treatment.
4. Specifications for treatment in relation to kind of material and service requirements.
5. Investigations and recommendations for preparing timber for treatment.
6. Service tests of zinc chloride alone and in mixture with creosote in the East and Southeast, and of minimum injections of creosote.

E. A. STERLING, *Chairman*,
CARL G. CRAWFORD,
C. P. WINSLOW,
WM. A. FISHER,
LOWRY SMITH,
GEO. E. REX,
O. P. M. GOSS,
J. B. CARD.

THE PRESIDENT: Now, gentlemen, you can hardly appreciate the amount of work this Committee has done unless you were a member of the Committee. I want to thank the Chairman and the members of the Committee for the work they have done. Is there any member of the Committee who wants to add anything to what Mr. Sterling, the Chairman, has said If so, I will recognize a member of the Committee first. I will recognize any member of the convention to discuss this question or to make a motion. What is your pleasure? Let us do something, gentlemen.

MR. H. A. PAUL: At the top of page 10, in connection with the empty-cell process, it says under 3-A:

> Where preliminary air pressure is used from 50 to 110 lbs. air pressure shall be produced, and maintained in cylinder for at least 30 minutes. The intensity and duration of this pressure shall be governed by the character of timber being treated.

Now, this is the Rueping process, and Mr. Kuckuck, who has represented the process in this country, has stated a number of times before these conventions that this intensity and duration of pressure, that this process was a treatment to refusal and then of recovery. I think that is the main point why it is acceptable to so many, that it is a refusal treatment, but it does not so state here that it is a treatment to refusal.

THE PRESIDENT: Has anyone else anything to say on this question.

MR. GEO. E. REX: Mr. President, with reference to the remarks Mr. Paul made, I think, as he understands it, this paragraph 3-A "Preliminary Air Pressure," refers simply to the preliminary air and not to the pressure during the introduction of the preservative whatever. The air is simply the amount of air put in, and the process may then be carried on to refusal in accordance with our practice.

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MR. H. A. PAUL: If it is all right, then why do you say "under pressure?" That pressure refers to the preservative pressure. What does 5 say? The same as Specification No. 1. I would have the refusal put in there in the case of the Rueping treatment, because Mr. Kuckuck has so stated before the convention.

MR. W. H. FULWEILER: Mr. Chairman, is this a secret?

THE PRESIDENT: You gentlemen do not talk loud enough so that the other members can hear. Go ahead now.

MR. H. A. PAUL: What I wanted to have made clear was the pressure of the preservative maintained to refusal, and it says here on page 10 under paragraph 5 "same as Specification No. 1," and Specification No. 1 on page 8, paragraph 5, says:

> The temperature, and intensity, and duration of pressure shall be maintained in such a manner as to secure the greatest possible distribution of penetration, with the specified amount of the preservative.

That is hardly as clear as Mr. Kuckuck insists the treatment was. He insists that the treatment is to refusal.

THE PRESIDENT: You have nothing to say on it, Mr. Rex?

MR. GEO. E. REX: No.

THE PRESIDENT: Has anyone else anything to say? Now what will you do with the report? Did you make that as a motion, Mr. Sterling?

MR. E. A. STERLING: I was not sure whether it was proper or customary, Mr. President. If it is, as a matter of form, I move that the report be adopted.

THE PRESIDENT: What is the pleasure of the convention?

MR. W. A. FISHER: I second the motion.

THE PRESIDENT: Mr. Sterling has not made a motion. He is too modest. I do not blame him, and I think he is right.

MR. A. C. BECKER: I move the report be adopted.

MR. W. A. FISHER: I second that motion.

THE PRESIDENT: Now it is moved and seconded that the report of Committee No. 2, as printed and revised, be adopted. Has anyone anything to say on this question. Those in favor say Aye, opposed No. The Ayes have it.

Now, these wood block fellows, they are the best bunch in the country, and we are going to start them, but we are going to stop them. That is, for a little while. I promised Dr. von Schrenk that at 3 o'clock he could present his paper. After that we will take up wood block flooring and the report of the two committees.

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The Chairman has been requested to announce who the Nominating Committee members are. I thought everybody knew, but, of course, I forgot that some of you were not here at the first meeting. Mr. R. Van Metre is Chairman, Mr. Card, Mr. Pollock, Mr. Mattos and Mr. Steinmayer, are the members of the Nominating Committee. They will report tomorrow as has been our custom.

Now, Dr. von Schrenk.

FUNGI WHICH GROW ON UNTREATED TIES OR UNTREATED WOOD.

Dr. H. von Schrenk.

Mr. President and gentlemen: The subject that was assigned to me, I believe, was "Fungi which Grow on Untreated Ties or Untreated Wood." While that is part of my subject, I have taken the liberty to enlarge upon that a little bit, and to talk in rather a rambling sort of fashion on several subjects. The problem which appears to me to be of increased importance to the wood-preserving industry is the relation of fungi, not only to untreated wood, but to treated wood.

One of the principal problems confronting the entire industry is the question of the efficiency and service of treated material. In the early days of the wood-preserving industry we paid very little attention to the class and character of the material that was actually treated. While there has been a tremendous improvement in regard to this particular feature of the question there is much yet to be demanded and much to be learned. I have put here on the table a number of typical samples of wood such as we frequently meet with in practice. You will note that these refer mostly to railroad ties, because as far as the volume of treated material is concerned, and owing to the greater attention paid to railroad ties, we have more samples to choose from.

I think it can be admitted by everybody that there is absolutely no use of treating timber and expecting any service unless that timber be physically fit for the particular purpose for which it is intended before it is ever treated.

In investigating records such as Mr. Kendrick spoke about yesterday, and as has been frequently referred to in these meetings as to service, we are confronted continuously with the problem of trying to explain why certain treated wood failed after a period of time which we all recognize is shorter than should have been anticipated. But in the last two or three years a great many investigations have been made to find out what the relationship was between the timber that was treated and the treating process. I have been very much surprised to find, and I think it has been the experience of others, that where we have failures of treated materials there is generally some fairly good

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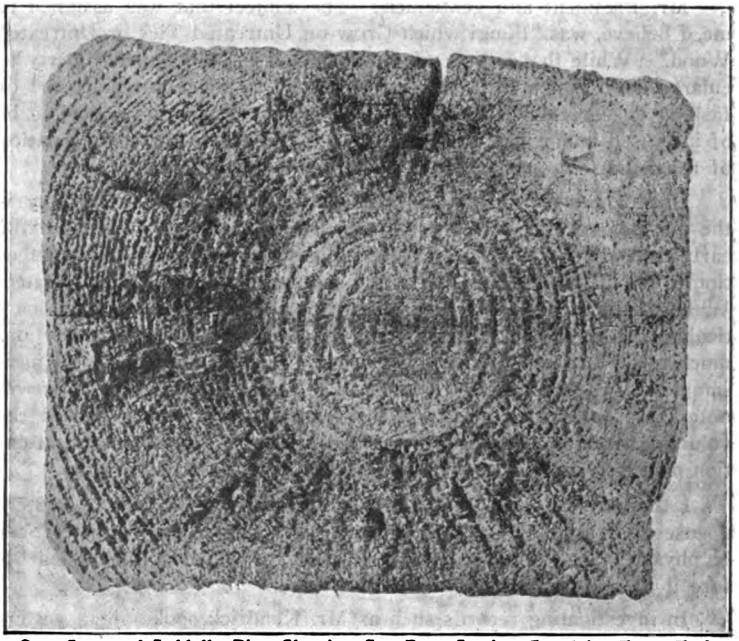
reason why there has been such failure, and my whole reason for appearing before you today is to dwell briefly upon some of these factors which have contributed to so-called failures. They may be briefly classed as failures due to the improper quality of the material when it was treated, to improper preservatives used, and lastly to improper method of applying the preservative and possibly one or two others which might be added, but those three are the significant ones.

As to the quality of the material to be treated, the class of timber which we usually treat these days is subject to decay. That is probably the chief reason why we treat it. It therefore seems almost useless to point out that if the material is already decayed before we start treating it that we cannot expect anything from such material other than



Over-Seasoned Loblolly Pine Showing Sap Rot—Section Cut 6 in. From End.

disappointing results. In spite of that fact, however, we still find a failure to recognize in a great many parts of the country, not only on the part of those who actually treat timbers, but on the part of consumers, the tremendous significance of the proper preparation of timber before treatment and the necessity for the most regid methods to be used in handling such material before it is actually treated.

It is hardly necessary for me to point out samples of that character. I have here two or three pieces of oak ties that were picked out at

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random at various points in the United States to exemplify what I am driving at, to exemplify particularly the evil of the timber-treating industry, which has come to be generally known as internal sap rot.

Here is a red oak cross tie which has been held in a yard or which was from the time of cutting until actually submitted for treatment about 20 months old. You will note as a general rule the outside looks very sound and very well.

There are some fungi, to be sure, growing on the outside, but when cut through a very large percentage of that timber is absolutely gone. There are a great many other instances in which the evidence of the outside rot is very small. Here, for instance, is one in which what are

View of End of Red Gum Tie. (This shows the fungus causing internal sap rot.)

very common large forms occur and the effect of that is easily visible 1 in. from the end of the cross tie. Here is a similar cross tie 18 months old, absolutely not a sign of a defect on it to be distinguished either with the naked eye or lens. Yet, when you cut that off a very large portion of the interior of the tie is gone. Now, gentlemen, it is perfectly startling when you come to hunt for these to find how frequently they occur. Here is a rather insignificant looking reddish yellow mess of slimy material on the end of a beech tie which to many of us had no significance until a year or two ago and which we watch now with the greatest of care, because we have learned to understand that this particular fungus is one of the most serious which we have to

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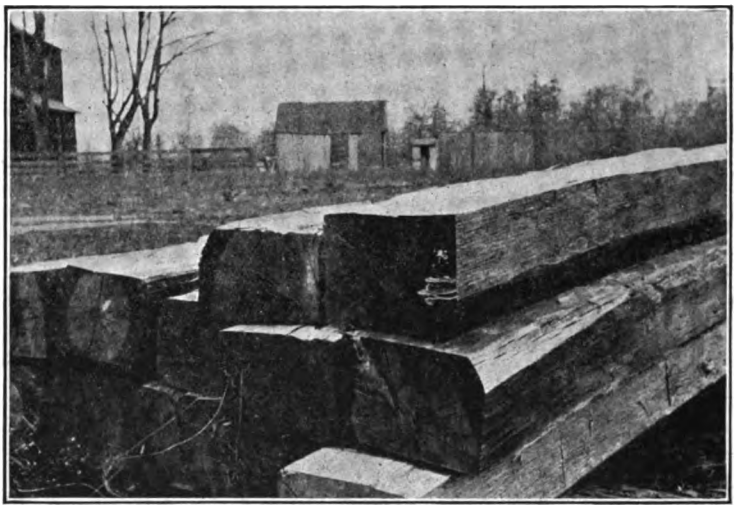
meet with in treating yards. Here is the other side of a particular piece of beech. This particular fungus grows on particularly everyone of the hardwoods that we are fond of treating at the present time. Even such insignificant bunches as these here, having the shape of the ordinary toadstool which grows on the outside of the tie, we have come to recognize as one of the most serious forms of defect. In fact, you can see that in this particular tie there is not one per cent of sound wood left.

Now then, gentlemen, the significance of all that is of course, perfectly obvious, and the chief point I would like to leave with you in connection with this phase of the matter is the understanding that all timber is subject to decay from the time it is cut from the tree until it



Sound Looking White Oak Ties. (Note fungus on one tie. Over half of the ties in this pile were sap rotten.)

actually arrives at the treating cylinder, and a wider recognition of the fact that one must be suspicious of every stick of wood that is handled in the treating industry from the time he orders it or purchases it until it has actually been put into the treating cylinder.

The conditions under which those particular fungi will prevail are known to some extent, to some extent we do not know them. I refer particularly to the resisting powers of different grades of wood under normal, practical conditions. Such a simple thing, for instance, as the relative resistance of various classes of yellow pine coming from different trees in relation to their resin contents about which there has been a good deal of discussion in the technical press during the last year

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is still a comparatively sealed book to most of us. I put on the table here two jars to which I invite your very careful consideration and ask you to handle these just as little as possible, please, because the specimens in them are recorded samples which are still under observation. I simply bring these to you to show how such problems are being attacked these days from a pathological standpoint. You will note in each one of these jars a small number of blocks which have been under observation for a little over a year at the present time. These form part of a series numbering almost up to 3,000 individual pieces, each one of which has been very carefully kiln-dried, very carefully measured and weighed, and each block has had its resin contents very carefully determined and the number and amount of the growth of the rings; in other words, they have studied each case. You will notice a rather interesting sample in this particular jar showing we have had these under the exact conditions of service. You will see the normal development in this culture.

Simply as a matter of interest I have brought a number of pure cultures of these various organisms in these tubes here to show you the manner in which we get inoculated material for transferring them under exact conditions, such as obtain in a bacteriological laboratory, to the various individual pieces of wood. I do not want you to go away with the impression that this is purely a laboratory performance. Here is a similar culture of Polystictus which grows on oak to show you how luxurious a growth it is possible to obtain of these particular fungi in the laboratory. I would not have you go away thinking that this is purely a laboratory determination because determinations of this character are after all only indicative. It is all well enough to generalize on some of these factors as we find them from cultures, but the practice, as illustrated by these specimens, is after all what most of us are interested in. In other words, the commercial applicability and feasibility and practicability are points which are found from such determinations as I have referred to. That is, in each individual case where a timber is treated a specific study should be made by those in charge of the particular material of the probabilities of decay causing losses in such tie yards when balanced with the rate of evaporation that takes place from those timbers before they are fit for treatment. In other words, it is possible in one part of the country to hold red oak ties twelve to fourteen months and still be perfectly save that the majority will not become defective, and in another part of the country it is not safe to hold them more than eight or nine months. In other words, an absolute standard cannot be established that will have to be determined in each instance. Much can be done, however, in arriving at the condition where great safety may be obtained by observing some of the elementary principles surrounding or determining the growth of these fungi; these are cleanliness in the yard conditions, removal of all decay pro-

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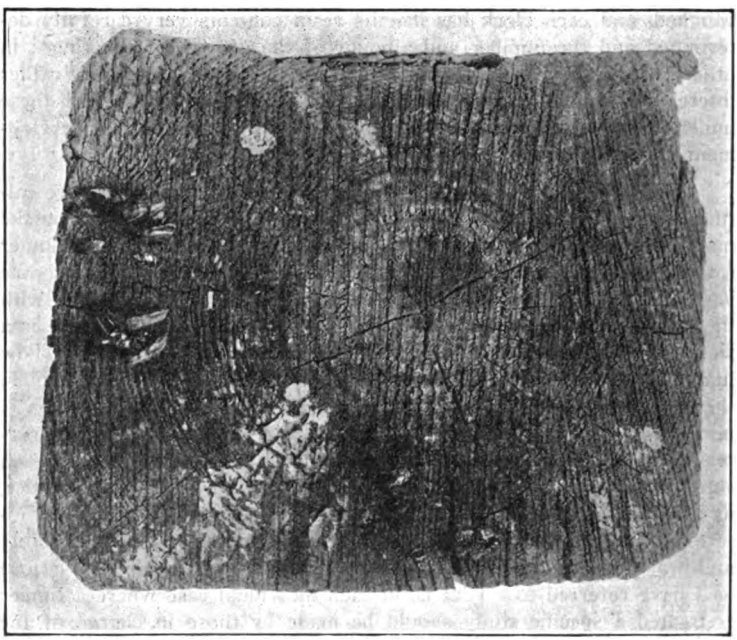
ducing sources, in other words, rotten pieces of wood and bark and so forth, thorough drainage, so as to reduce the per cent of moisture in the atmosphere and the arrangement of timber yards in such a form that the maximum wind velocities, the maximum air circulation shall be obtained through the piles. The possibilities in that direction I am certain many of you do not appreciate. I remember one yard which we had to deal with some three or four years ago showed losses as high as 5%, 6% and 7% of the material stacked. This year in handling between 700,000 and 1,000,000 ties in that particular yard there were not



End view of Tie Showing Fruiting Bodies of Fungus (Lenzites Sepiaria) Causing Sap Rot.

one hundred ties culled which had been held from periods varying from 12 to 15 months. In other words, the material can be kept in such shape that the loss will be small.

Another important factor I find in this connection is how to tell the decay. From the samples which I have here, and I urge you to look at them carefully, you will note that many times you cannot see the decay. There you have to handle the problem on a basis of probability, and that, of course, can be done only after a great many years of practical experience in testing. We found the pine ties looked perfectly

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sound after five or six months and when you saw off 1 in. or so they may be decayed as badly as the particular sample I have here on the table. In other words, you look at the back side of this and there is absolutely not a crack or spot or anything from which even the most careful research would detect anything, and still look at it! The same is true to a very similar degree with hardwoods, and the only safe basis upon which to rely on your inspection service is when you are inspecting to saw off the ends of a considerable number of ties, get into the habit of doing it and you will thus learn the actual condition of the material.

We jump now to the phase of the problem which in many respects is as significant as the inspection of raw material, because it teaches a good many lessons about treatment in connection with this problem of the growth of fungi on so-called treated wood. Right here I wish to draw a very sharp distinction in the matter of inspection and particularly in getting data on service of treated material. We unfortunately have few words in the English language which are capable of accurate definition in regard to treated material. We find an increasing tendency in literature and magazine articles which are headed decay of treated creosote or zinc chloride treated woods. Not long ago at a meeting of the American Institute of Electrical Engineers a very valuable paper was read on the experience of a long distance telephone company with creosoted telephone poles, and throughout the paper mention and reference was made to such a percentage of poles "decayed" in five years or ten years, whatever the case might be, and as an actual matter of fact those poles had not decayed, at least not the part actually impregnated with creosote oil. The part that had suffered decay was the part underlying the treated layer, and some bright genius who is able to coin new words will sooner or later devise a word which will accurately express what we mean when a piece of treated timber fails so that there may be no misunderstanding as to the difference between the decay of impregnated parts and the unimpregnated parts.

I have one or two instances relating to this particular point. Some years ago at one of the treating plants some beech ties were treated, 8 ft. long. After treatment these ties were sawed in the middle and were used as tram ties. In other words, one end of each tram tie was the original treated end and the other end was the part that had been sawed through, that had received no treatment. After serving in track about five years we were very much surprised on inspection one day to find growing out of the ends of these so-called creosoted ties enormous bunches of fungi. Here is a typical example. This, mind you, was a creosoted piece of beech found in the track cut off. You will note that the sapwood of this particular beech was thoroughly impregnated with creosote, and the heartwood is practically wholly destroyed. We also had the tie cut in the middle. This was by no means an isolated

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instance. There were several hundred of these ties, each one of which showed exactly the same appearance. In other words, we had decay taking place in the uncreosoted wood whereas practically no decay took place in the actual wood fiber filled with oil. If I had the opportunity of explaining here the various materials which we have collected during the last six or seven years in following up this matter I might have filled this entire room with similar instances. I have only one more.

Not very long ago in making an inspection of the new wharves built by the New Orleans Dock Board, the inspection party was very much surprised when we came to a stringer which had not been out of the treating cylinder more than six months and found this fungus growing on it. The stringer was thoroughly creosoted except in a small section where this particular fungus was growing. An examination of this particular piece will show at once that no creosote oil occurs in the decayed part which we confirmed by microscopical and chemical tests. Similar instances occurred in Texas, Oklahoma and Arkansas to my personal knowledge on telephone and telegraph lines. I want to suggest incidentally here that I very much appreciate receiving advices of similar instances, that many of you doubtless come across in the course of your work. The significance of that, gentlemen, is that we have to deal with comparatively new points of view in the treating industry, namely, the failure of the unprotected portion of the timber. We all know in spite of our urging for complete penetration and so forth that that cannot always be obtained, in fact, that is not always necessary, but that the experience as shown by these examples here is sufficiently indicative of the fact that we are going to have increasing evidences of so-called failures of creosoted materials in the future.

I have here three tie sections which illustrate a very similar thing on various lines with which I am associated.

I have had instructions issued that every creosoted or treated tie taken out of the track must be saved for a direct inspection before being destroyed so we can see what happened to it. On some of these railroads during the last year or two ties have been coming out in which serious signs of decay were found. Here is one very striking instance of this. Here in a tie laid in 1910, removed in October, 1915, a creosoted tie, and it is needless for me to comment on it, on why that was removed. I have two others here which unfortunately are so broken I cannot lift them up to show them to you. Each one of these instances shows the reason why these ties failed. Why the fungus grew so vigorously therein was because these were entirely sap-rotted before they were impregnated in the treating cylinder. In fact, in the majority of these cases, and I have had probably 400 or 500 or 600 of them within the last year, are specifically to be attributed not to condition of the tie after it was once in the track but to the incipient decay which

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was within the tie at the time the timber was treated. Furhermore. an interesting thing has come out of these researches, namely, that the mere surface impregnated (because the decayed portion absorbs very little creosote) apparently has very little influence upon the vitality of the organism contained within the untreated section of the wood. In other words, it keeps on growing just as it did in the particular case under the observation of the New Orleans Dock Board.

Your Committee in endeavoring to formulate a paving specification spent a great deal of time this year trying to find out what paving oils had really done and whether there was any indication in the service records in the various cities of this country or abroad as to the relationship between paving oils and resultant service. Before coming to this paving problem I will run through a few of these slides showing typical fungi growing on cross ties and other structures. You would not expect to find on one of the commonest kind of red oak throughout the east such perfect fruiting of fungi. The fungus is nevertheless extremely common.

Here is a typical photograph illustrating the structure of these so-called toadstools. I call your particular attention to the diagram at the center at the right-hand side showing the spores coming down. There are millions of those spores discharging. The number of small bodies these fungi discharge is almost incredible.

Here is a typical instance of this sap rot showing particularly the sound outside shell entirely free from any signs of decay while immediately inside, ¼ in. or so the wood is entirely decayed.

Here are two logs taken out in the forest showing the growth of typical fruiting bodies. Here is that same fungus growing on a gum tie. This slide shows how completely the sapwood is gone. Note the high resistance of the heartwood.

Here is a pile of separate ties which have been allowed to remain in a tie yard and may serve as a striking example of what may happen to a yard with a large number of piles providing only one pile such as this is left. You will note that practically everyone of those ties is badly infected. This photograph was taken only a few months ago from one of the largest tie yards in the country.

The next slide will show you a series of investigations made abroad several years ago to determine the factors which control the growth and development of these wood-destroying fungi. This is the so-called blue stain.

Without going into details here I call your attention to the fact that there was definite relation between the percentages of air and water contained in the wood fiber. The figures show practically no growth, and if the percentages of air and water in the ties are about

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equal the fungi will not develop, such for instance, as 8%, 9%, 10%, 11% and from 47% up to about 59% of air, and from 11% to 5% of water. There you obtain the optimum conditions under which the fungi grow. That explains why in so many cases the outer shell is free from decay.

Here are a series of pile sections taken from a bridge in the Southwest, of so-called creosoted piles. The sections are cut in lengths of 1 ft. each, beginning at the top. The sound section there is the section at the ground line, and the sections going to the right and beginning again at the left-hand side are the sections going up towards the top of the bridge. You will note the outer shell which was impregnated with creosote oil is perfectly sound while a very large percentage of the inner sapwood which received no treatment whatever has decayed entirely. Instances of this character are of increasing frequency, throughout the Southwest particularly.

This shows up a little clearer, shows the decay of the inner sapwood. Another view of the center section. One of these bridges, practically 98% of the piles had to be condemned because of decay from the cap down towards the ground line.

Coming now to the question of the paving block specification and treatment, we spent a good deal of time in various cities of the United States investigating what service had actually been obtained from paving blocks in trying to formulate a specification for the oil with which the blocks should be treated. To make a long story short there were found instances of defective paving blocks occurring with increasing frequency in various cities and by no means confined to one place. We found furthermore that these defects appeared first of all as individual blocks in the street. Then in clumps, sometimes as many as 200 or 300 in a bunch. Furthermore, that the appearance of these defects had practically nothing to do, except in two instances, with the preservative used; that is, some were light creosote oils and some heavy and it did not seem to make any difference what kind of oil it was, referring, however, only to the coal-tar products. In the case of the water-gas-tar a different result was found. You see before you a street, the particular one, I believe, is either Westminister or Washington Avenues, St. Louis, in which some of the paving blocks appear to sink down from the top.

The next slide, I think, shows a piece of repaired portion of the street from which you can gain the idea of the extent of the sizes of the patches. The next slide will show you one individual block, magnified very considerably, to show the peculiar appearance of the block in the street. You will note that all around the block the pavement is perfectly sound and hard, not a sign of any defect anywhere. Now and then, we find a block of this character which was temporarily filled

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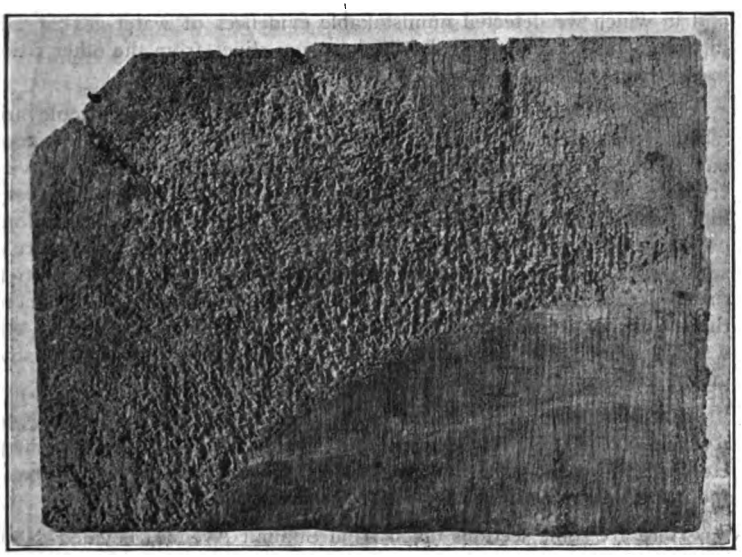

Section of Red Gum Tie 6 in. From End Showing Internal Sap Rot.

with tar and later on had to be removed entirely. Here are six blocks which were taken from Washington Avenue, the blocks were treated in 1904. You will note the various states of this depression, the one in the lower left-hand corner being perfectly sound and going up until the last one in the upper right-hand corner shows a very striking case of the defect.

Here are these same six blocks viewed from the lower side.

I call your attention furthermore to the fact that in the squashing-in process all the disappearance was entirely in the outer rings of the sapwood of the paving block.

Here is a section of four of those Washington Avenue blocks. I want to call your attention particularly to the lower two blocks, and particularly to the one in the lower left-hand corner, in which you will note a ring of preserved material completely encircling in the heartwood, the heartwood having no penetration, note the spots here and there showing decay, in the preserved ring. The same is also true of the two blocks in the upper tier.

I may say these Washington Avenue blocks were carefully examined as to their oil content and this, aside from any other blocks found in one other city, are the only paving blocks that we discovered in which a failure of this character took place in the creosoted ring

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and in which we detected unmistakable evidences of water-gas-tar additions in the preservative. I will show you slides from the other cities presently.

Here are some similar specimens from Westminister Boulevard which were treated in 1904 at the same time as the Washington Avenue pavement, but were treated with a comparatively low specific gravity creosote oil, having a gravity, as I remember it, about 1.03 with a very high percentage of low boiling compounds. Note the same indications of decay in the sap ring. Note, however, the difference in the cross section. You will note that in this particular case the only portion that is decayed is in the sapwood. You will note that everywhere where there was any creosote impregnation at all in the wood fibers there the wood is sound. The only place where there was apparently no creosote oil the wood fibers were thoroughly decayed.

Here is a similar series of blocks taken from a street, Robinwood Avenue, Toledo, O. Note again the sinking down of the sap ring. Here is another lot from that same street, Robinwood Avenue. Here is another set from a different part of Robinwood Avenue.

Here are some sections taken from Summit Avenue, Toledo. Note in particular the lower right-hand corner; the heartwood in that particular block was black through with creosote oil; no evidence of any oil whatever in the sap ring. Note the same in the large block immediately above it.

Here is another case of distinct failure of a treated portion. These are some blocks taken from the cities in the southwestern part of the United States treated with almost a straight water-gas-tar. There was very little evidence of any coal-tar whatever. Note again the decay in the sap ring.

I would not have you go away with the impression that all of the wood blocks examined showed these defects. Here is one which you will note is black through. Here are some showing no penetration in heartwood, some showing very slight penetration, just as sound as the day they were treated, but I would have you observe in each instance every particle of the sapwood of those blocks was impregnated with the preservative. These blocks were laid in 1904 and removed this year.

For a long time it was puzzling to us to determine how in the world you could treat paving blocks and have the heartwood thoroughly impregnated with black oil (and in some of them the oil was present in such quantities that it could be squeezed out in a vise) and yet show so small an amount of oil in the sapwood. I have always thought that the sapwood was easily penetrated and that the heartwood could not be treated, and here we have the reverse, namely, no treatment in the sapwood and a very full and complete penetration in the heartwood.

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We did not get on to the connection between this decay factor and the impregnation feature and the explanation why the fungi could grow in that sapwood, until after examining a great many stages of these blocks we finally found two or three in which the sapwood was still comparatively sound and the heartwood completely black with creosote oil and a slight ring of black oil around the edges of the sapwood. You will note in this block a roughness in the sapwood, a microscopical examination of which showed the incipient stage of decay due to the growth of one of the timber-destroying fungi. In other words, obviously here is a block that had gone through the treating cylinder and the heartwood had absorbed a lot of oil, but the sapwood only a thin skin.

I could not believe that was a matter of actual practice, so we began hunting around the various treating plants in the country to see whether such a thing was going on at the present time, and, gentlemen, here I have four blocks which I have picked out from a considerable number that came from two different cities. Note the white sapwood and black heartwood. These blocks were treated with high boiling distillate oil. It would be just as absurd, gentlement, to say, that this lack of penetration of sapwood in case of these particular blocks was due to the high distillate creosote oil that was used, as it is absurd on the other hand to say that when such indications are obtained with a mixture of creosote and coal-tar that is the reason why that should or should not be used. In other words, as I tried to show this morning, the character of the oil has not a thing to do with this problem. It is absolutely secondary and insignificant. The problem is one which is altogether along entirely different lines. You will note here two or three samples of similar blocks which I have on the table. These blocks were treated under contract for two of our western cities, not very far from where we are sitting, and show an unusual condition. In fact, I have lots from three different cities here on the table. Note the left-hand block. Most all of the sapwood is perfectly white, with only blotches of creosote oil in it. The second one is the same. The third one is the only one of them that did not receive such full treatment and this particular block on the extreme right-hand side and practically very little oil in the sapwood. Now, the reason for that, which we have figured out so far, is probably not in the oil but in the process under which the oil is injected into the block and the methods which are used in order to obtain such penetration. That is due, probably, entirely to the fact that the moisture contained in the sapwood in these particular instances prevents a proper penetration of the sapwood. It is like having a bottle full of water and trying to force creosote oil into it. The heartwood with a comparatively low moisture content had received a very thorough impregnation. These rotted blocks are coming out in increasing numbers. There is hardly a week that goes by at the pres-

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ent time that I do not receive samples of exactly the same kind from various part of the country. I was very much interested last week in spending an hour or more on the Plaza in front of the Pennsylvania Station at Washington, studying the beautiful piece of paving block work to find possibly five or six showing exactly the indication which I showed from the blocks from Westminister and Washington Avenues, St. Louis.

In order to find the relationship between the absorption of these various kinds of paving oils, we made a very extensive series of tests at various treating plants to determine the actual absorption of the different oils in one run of paving blocks. I want to throw on the screen just one or two slides illustrating this. Here are 100 paving blocks which were weighed before and after treatment. The lower line indicates the weight of the block before treatment, both in pounds per cubic foot and in ounces running in pounds from 40 at the extreme left to 80 at the extreme right in vertical lines, indicating the absorption in pounds per cubic foot, also the ounces for the individual blocks, and you will note the variation runs from 30 at the top down to 2 lbs. per cubic foot at the bottom. One paving block weighed 78 lbs. per cubic and took up not quite 2 lbs. of oil per cubic foot upon treatment, while the great majority was at the upper end. I call your attention furthermore to the fact that this was an oil with a specific gravity of 1.10 with 34% residue. In other words, this was an oil which is practically in accordance with the specification which was presented by your Committee this morning, taken, by the way, from the standard of one of our large eastern cities.

I think I have one more here treated with coal-tar creosote with a somewhat heavier addition of coal-tar. You will note the general bunching of blocks towards a 45-lb. weight and 15 lbs. absorption of creosote oil.

Here is the rot in the actual blocks from which one of these slides was taken. Here is one in which you see exactly how the sapwood remained white. This, gentlemen, is a rather serious state of affairs which we can talk about in the family, but I hold this, that there is no use closing our eyes to the fact that there are problems connected with our industry which we do not quite fully understand, and my plea this morning for some abatement in the excitement attendant on the specifications was based somewhat on this type of study, because it has come to be realized among the taxpayers and among the engineers that these are the kind of things they are seeing.

It is not very pleasant to live on a block where the city has to spend a good deal of money because we have been spending our time talking about creosote oil specifications and paying no attention to the method of treatment and the problem or appearance of decayed por-

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tions of wood. That is a phase we should all watch out for in a friendly critical spirit, each for the other, in order to obtain more data. These points that have been brought out here today are the result of the work of three of your Committee who have been pretty busily at work during the last year on this problem. There are several hundred of you. Each one of you will find numerous instances of this sort, and I can predict with considerable confidence that if we keep our eyes open to the reasons why we get these defective appearances in timber, such as I tried to show you here today, that it will be one of the most constructive forms of advancing this industry, not only for ourselves but for those for whom we are actually seeing that timber is being treated (applause).

THE PRESIDENT: Doctor, it is not necessary for me to thank you for the work you have done for the American Wood-Preservers' Association. This audience in its response says a good deal more than I could say.

Now, is there anyone who wants to ask the Doctor any questions or discuss anything he has said?

MR. C. N. FORREST: Mr. President, there is one thing that impressed me more than anything else in connection with the wood block that Dr. von Schrenk has shown; that is, the very imperfect impregnation of the wood. Most of these, or a great many of these samples that have shown defects that he has described are only partially saturated, and it has been our experience in handling such paving blocks where 20-lb. treatment of almost any sort of an oil, particularly water-gas-tar, has resulted in a block that is black all the way through. I should think there would be a very different result in service as between blocks that are thoroughly impregnated and those that are only partially impregnated as a great many of these samples seem to be.

DR. H. von SCHRENK: May I answer the gentleman? If he will come to my laboratory some day I will show him many blocks treated with water-gas oil of the same appearance. It is not a question of the preservative, it is a question of whether the wood is already full of water. It is a question of seasoning and treatment, not of the preservative. I do not want anybody to go away with the impression these defective blocks occur by the hundreds of thousands. These are picked individual cases from probably 15 cities where they have been showing themselves during the last year. The only blocks that showed rot in the treated portion were water-gas products.

THE PRESIDENT: Dr. von Schrenk showed that the sapwood was not treated and the hardwood was, and I think he explained very thoroughly why, because the sapwood was full of water and the heartwood was better seasoned. Is that the statement you made?

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DR. H. von SCHRENK: Yes.

THE PRESIDENT: Now, is there anyone else who has any compliments or criticisms? The Doctor can stand either (laughter), I do not know that I can say any more, but I personally appreciate the work he has done.

The next will be "Treated Wood Block for Factory Flooring and Miscellaneous Uses," by Mr. Teesdale, and then after that we will take up the reports of Committees No. 3 and No. 6.

MR. C. H. TEESDALE: This paper on wood block flooring is submitted by the Committee on Wood Block Paving as information. It was prepared as the result of letters of inquiry sent out to the manufacturers of paving blocks and to as many of the users of wood block flooring as we could obtain the names of. The letters which we wrote to the manufacturers brought out a very important point, namely, that blocks which are used for wood block flooring in very dry situations, as in factories and warehouses, should be given a different treatment than those that are used in wet situations or in alternately wet and dry situations because of the trouble from swelling in the latter case and shrinking in the former case.

Blocks which are laid in dry places will give trouble from shrinkage if they are more or less green when they are laid. On the other hand, if they are very dry and are closely laid and the situation is wet or likely to become wet at times, they may give trouble from swelling. Hence there are two very well defined cases, and each one should be studied by the manufacturer when an order is received. Those are the main points which are brought out in the inquiries that went out to the manufacturers.

The question of the kind of preservatives in general use, the absorption of preservatives, the treatment that is being given, methods of laying, etc., are discussed in the paper but I will not take up your time by reading them. The letters which were written to the users of wood blocks brought forth replies giving the results obtained and those results have been tabulated in the large table included in the paper. The best way of describing that, I think, will be to read the general discussion at the end of the paper.

TREATED WOOD BLOCK FOR FACTORY FLOORING AND MISCELLANEOUS USES.

By C. H. Teesdale.

Since 1900 there has been a steady and rapid increase in the use of creosoted wood blocks for paving the streets of our cities. A more recent development, and one which promises to become an important source of business to the manufacturers of these blocks, has been their

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adoption for a variety of uses other than street paving. Those qualities which make the wood block desirable for street work it seems should also make it desirable for flooring where heavy trucking, the moving of heavy machinery, etc., make the maintenance of floors a serious problem, and its use has already been reported for:

Warehouses	Freight platforms	Garages
Factories	Loading platforms	Cotton mills
Factory courts	Station platforms	Paper mills
Foundries	Wharves and docks	Rubber plants
Machine shops (all kinds)	Ferryboats and approaches	Hospitals
Shops handling heavy machinery	Driveways	Laundries
Railroad shops	Bridges	Printing establishments
Round houses	Post offices	Hotel kitchens
Railway stations	Tennis courts	Bakeries
Freight houses	Barns	Fire engine houses
Express rooms	Stables	Milk depots
Baggage rooms	Slaughter houses	Breweries
Dumping platforms	Wild animal cages, runways, etc.	

Method of Manufacturing Wood Blocks for Flooring.

Letters were written to those plants manufacturing creosoted wood blocks requesting data on their methods of manufacture and construction. Not many of the treating plants in this country have as yet produced very much of this product. Reports were received from 13 commercial plants and one railroad plant. Three of these were in the West, and the remainder in the Central Western, Eastern or Southern States, but probably 90% of the output has been from less than half of these concerns. Eleven additional plants reported that their product had not been used for flooring. All of the concerns manufacturing large quantities of wood block, except one, replied to the inquiry. The replies from these plants are given in a condensed form in Table 1.

Species of Wood.—Eleven of the plants reported the use of Southern yellow or longleaf pine for this purpose. Five plants also recommended Eastern tamarack as being satisfactory, and the three Western plants recommended Douglas fir; black gum, beech, Norway pine, maple, hemlock, and Western larch were recommended by one plant each.

Several of the plants, particularly those producing the largest quantity of this material, pointed out that the wood block flooring problem naturally divides itself into two classes:

A. Blocks used in very dry situations, as in factories and warehouses.

B. Those used in alternately wet and dry, or in wet situations, as in stable floors, docks, wharves, slaughter houses, etc., where the blocks are exposed to the weather, to flushing with water, etc.

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The treatment and method of handling the blocks differs radically in the two cases. In Table 1 the reports of the manufacturers have been divided, so far as is possible those under caption "A" designating dry situations only, and those under caption "B" designating alternately wet and dry or wet situations.

Preservative.—Eight of the 14 plants reported in favor of using a distillate creosote oil. Three plants recommended paving oil similar to that quite generally used for wood block street paving. One recommended water-gas-tar; one carbolineum; one a mixture of half water-gas-tar and half zinc chloride solution; and one a mixture of half water-gas-tar and half coal-tar creosote. The last mentioned product was, however, recommended only for wet situations, this plant recommending creosote injected by the Rueping process for dry situations. The concensus of opinion was to use a distillate creosote, especially for dry situations, and a heavier paving oil for wet conditions.

Absorption of Preservative.—In general, the plants were not very specific as to the absorption of preservative that they recommended for the two classes of blocks. The inference to be drawn, however, was that comparatively light absorptions (from 5 to 8 or 10 lbs. per cubic foot) would prove satisfactory for dry situations. Heavier absorptions, ranging from 8 to 16 lbs. per cubic foot, were recommended for alternately wet and dry or for wet situations. In general, the absorption to be given would appear to depend to a considerable extent upon the conditions met with in each individual problem, the more severe conditions especially as to the chance of the water coming in contact with the blocks, requiring heavier absorptions of oil. In the case of plants recommending paving oil and water-gas-tar, heavier absorptions were specified than when creosote was recommended.

Treatment.—It is evident that the use to which the blocks would be put has a very important bearing on whether the timber should be thoroughly dried out before treatment. Three of the largest producers of flooring pointed out that blocks which are to be used in inside construction, especially in factories or other situations where the buildings will be heated in winter and where the blocks do not often come in contact with water should be thoroughly air dried or even kiln dried before treatment; otherwise, if they are comparatively wet when laid they are liable to shrink badly in the floor and become loose. However, if the blocks are to be subject to alternately wet and dry conditions, swelling and heaving are liable to take place if they are too dry when laid. Not all of the plants heard from reported on whether they would prefer to treat green or dry timber for this purpose. However, all of the plants but one reporting on blocks for inside construction preferred air-dry material. One plant specified either air-dry or green. The majority of the plants also preferred air-dry material for blocks in

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wet situations, although two plants specified their preference for green material and three for either green or air-dry material.

Steaming the Timber.—Of 12 plants replying to this question seven stated that the timber should not be steamed before treatment, and one not if the timber is dry, One plant preferred to steam lightly in winter, and three plants answered yes to the question. The concensus of opinion, especially in the case of those plants producing the larger amounts of flooring, was not to steam the timber.

Methods of Laying.—Most of the plants stated that a concrete base should preferably be used. Six of the plants, however, stated that where the concrete was not practicable, treated plank would be satisfactory. One plant stated that treated plank foundations should always be avoided, if possible. One plant specified sand and cement base. Practically all of the manufacturers agreed that expansion joints were necessary. Those who reported specified joints ranging from ½ to 2 inches and filled with bituminous filler. Whether blocks are to be laid tight or loose appears to depend upon the use to which they are put. In very dry situations the preference was to have the blocks laid as tightly as possible. For alternate wet and dry situations the plants appear to favor comparatively loose laying. Most of the manufacturers favored a bituminous filler. One, however, specified cement filler, one either a dry sand or a cement grout filler, and one sand filler.

Results Obtained in Service.

Letters were written to a large number of users of wood block flooring, to obtain information on the character of the floors being laid and the results obtained. One hundred sixty replies were received and are tabulated in condensed form in Table 2. About 75% of the replies received describe floors laid in 1912 or later, while only three records were received of floors laid prior to 1909. This indicates the comparatively recent development of this type of flooring. For this reason also the time of service of these floors has been so short that not much information can be given upon durability. Table 2, however, is interesting in that it indicates the character of floors being laid, the kind of treatment given, the conditions of service, trouble that has developed, and the opinions that are expressed by the users.

The number and per cent. of the replies to each question as stated in Table 2 have been computed and are given in Table 3.

Methods of Construction.—The depth of block used varied from 2 to 6 in., but 3 in. was used in 56% of the floors concerning which replies were received. Southern yellow pine was used in 72% of the cases, while 15% did not reply to the question, the remaining 13% being divided between eight other species of wood.

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The replies concerning the preservative used are probably not very reliable. In certain cases it was known that water-gas-tar was used, though creosote was reported. The records were corrected in all cases where the preservative used was definitely known. The records as given in Table 2 show that 67% used creosote, 12% used paving oil, and 8% water-gas-tar, while the remainder used other preservatives, or did not reply to the question.

The reliability of the replies as to the process used is also probably uncertain. It is not likely that all who replied to this question were sufficiently well informed to answer it correctly. Thirty-eight per cent. did not reply, while 48% reported the Bethell process and about 9% the Rueping process. The absorption of preservative reported varied from 6 lbs. to 20 lbs. Nearly 60% did not reply to the question, but the largest number (9.4%) reported 16 lbs. About 19% reported 12 lbs. or less, and 22% reported 15 lbs. or more.

Concrete foundation was reported in 80% of the replies, the remainder being plank, dirt, tamped earth, etc., or not answering the question. Seventy-one per cent. reported the use of sand cushion, 12% cement grout cushion, and 3% bituminous cushions. Bituminous fillers were reported by 44%, and sand by 25%. Thirty-nine per cent. reported that expansion joints were used, while 41% did not use them, and 20% did not reply to the question.

Summing up, the general practice was to use 3-in. Southern yellow pine blocks treated with 15 lbs. or more of creosote per cubic foot by the Bethell process. These were laid with a concrete foundation, sand cushion, bituminous filler, and the question of using expansion joints depended on the local conditions in each case.

Difficulties Experienced.—Repairs have been reported in 32% of the records, while 62% reported no repairs. In most cases the repairs made were of a minor character, and as a rule, were caused by swelling or shrinking of the wood. In a few cases blocks were badly worn where heavy castings were thrown upon them.

Bleeding of the blocks was reported in 9% of the records, but was said to be objectionable in only 2.5% of the cases. Swelling was reported in 29% and shrinking in 27% of the records, (in some cases both swelling and shrinking were reported), and these troubles were the cause of most of the dissatisfaction reported. Swelling occurred when the blocks became accidentally wet, because of leaky roofs, bursting water pipes, near drinking fountains, and other accidental causes. Shrinking occurred in very warm or hot situations, and resulted in the blocks becoming loose and producing an uneven floor.

An interesting relation may be shown between the kind of filler used, and swelling and shrinking reported. Thirty-three per cent. of

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those using bituminous filler reported this trouble, compared with 55% of those using sand filler, 75% where cement grout was used, and 55% where no filler was used.

Eighty-nine per cent. replied that the blocks were satisfactory, while 5.6% did not reply to the question, and 5.6%, or nine records, stated that the flooring was not satisfactory. Of the nine unsatisfactory floors, shrinkage of the blocks was responsible for dissatisfaction in three cases, swelling in two cases, in two cases the blocks wore out rapidly, poor foundation in one case and improper laying in one case.

The advantages and disadvantages as stated in the 160 reports which were received have been recompiled in Table 4. In a large proportion of cases it was reported that wood block was easy on the feet of the workmen and that they like to work on it. Noiselessness, ease of repairs, low upkeep cost, good trucking surface, saving of breakage in tools and fragile metal parts dropped on the floor, warmth, and cleanliness were all reported as advantages of wood block flooring in 10 or more of the records. Durability was reported as an advantage in 77 cases, though it is doubtful if many of the floors had been in service sufficiently long to warrant a statement as to durability.

In 14 records swelling was given as a disadvantage and shrinking in 12 records. Roughness, reported in 11 records was mostly caused by shrinkage. High cost was given as a disadvantage in 11 cases.

General Discussion.

The results of this investigation indicate that treated wood block makes a desirable type of flooring for many purposes, and it is likely that its use for interior work will increase. Since its large use for these purposes is just beginning, one might expect that unforseen trouble would develop. The records of 160 floors given in this report indicate, however, that serious trouble has developed in a very low percentage of cases.

Most of the trouble has come from shrinkage or expansion of the blocks. To prevent these troubles it is essential to study each case where blocks are to be laid, and to treat the blocks accordingly. For dry situations, the blocks should be well seasoned before treatment and laid in the floor while thoroughly dry. In wet or alternately wet and dry situations, dry blocks would give expansion trouble and, hence, the timber should be green or only semi-air-dry when laid. Even dry interiors are liable to be accidentally subjected to water, however; hence, it would seem desirable as a rule to use bituminous fillers instead of sand filler.

Sand cushions were probably a source of trouble in several cases. If there is any vibration, or if the sand is at all liable to shift, a bituminous or cement grout cushion is to be preferred. Sand cushions are

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TABLE 4.—ADVANTAGES AND DISADVANTAGES REPORTED IN USE OF WOOD BLOCK FLOORING.

ADVANTAGES.			DISADVANTAGES.		
No.	Per Cent.		No.	Per Cent.	
77	48	Wears well, durable, long life, etc.	14	9	Swelling.
45	28	Easy on feet of workmen, or men like to work on these floors.	12	8	Shrinking.
26	16	Quiet, noiseless.	11	7	Rough. Nearly every case due to shrinking, allowing sand cushion to shift or sand filler to settle under the blocks.
25	16	Easily repaired.	11	7	High cost.
19	12	Low upkeep cost.	4	2½	Blocks loosened. (Nearly every case due to shrinking)
13	8	Smooth, easy trucking, good surface.	3	2	Bleeding.
14	9	Good footing. Not slippery.	3	2	Slippery.
11	7	Saves tools dropped, castings, fine work, materials, kegs, etc.	3	2	Appearance. One on account of black color; one not so neat as a cement floor.
10	6	Sanitary.	2	1	Removed. One on account of swelling; one from swelling and shrinking.
11	7	Warm.	3	2	Unsanitary.
11	7	Dustless; clean.	2	1	Short life.
8	5	Easily cleaned.	2	1	Odor.
6	4	Resilient, pliable, shock absorber	2	1	Inflammable.
6	4	Easy on mules and horses.	2	1	Hard to keep clean.
6	4	Easy to move or set up machinery on, to put in pipes, etc.	1	1	Expensive to lay pipes under it.
4	2½	Save trucks.	1	1	Difficult to fasten machinery to floor.
4	2½	Non-inflammable.	1	1	Some blocks split.
5	3	Stands great abuse.	1	1	Wears rapidly where castings are thrown on floor.
4	2½	Dries quickly, waterproof.	2	1	Cut by steel borings and turnings.
3	2	Makes a solid floor.	1	1	Horses' calks catch in cracks between blocks.
3	2	Non-absorbent.	1	1	Ruts were worn, due probably to poor foundation.
2	1	Does not crack or chip when heavy castings are thrown on floor.	1	1	Sometimes men complain of its heating their feet.
2	1	Does not decay.	1	1	Pitch cushion expands and contracts.
2	1	Makes a neat floor.	1	1	Soils treads on tires in auto tire factory.
2	1	Keeps out flies, mosquitoes, etc.	1	1	Sand filler shakes down, causing roughness.
1	1	Not damaged by metal grinding into the floor.	1	1	Blocks float in brewery wash room.
1	1	Practical.	64	40	Did not reply.
1	1	Easily laid.			
19	12	Did not reply.			

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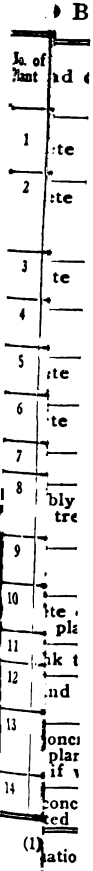

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TABLE 4.—ADVANTAGES AND DISADVANTAGES REPORTED IN USE OF WOOD BLOCK FLOORING.

ADVANTAGES.			DISADVANTAGES.		
No.	Per Cent.		No.	Per Cent.	
77	48	Wears well, durable, long life, etc.	14	9	Swelling.
45	28	Easy on feet of workmen, or men like to work on these floors.	12	8	Shrinking.
26	16	Quiet, noiseless.	11	7	Rough. Nearly every case due to shrinking, allowing sand cushion to shift or sand filler to settle under the blocks.
25	16	Easily repaired.	11	7	High cost.
19	12	Low upkeep cost.	4	2½	Blocks loosened. (Nearly every case due to shrinking)
13	8	Smooth, easy trucking, good surface.	3	2	Bleeding.
14	9	Good footing. Not slippery.	3	2	Slippery.
11	7	Saves tools dropped, castings, fine work, materials, kegs, etc.	3	2	Appearance. One on account of black color; one not so neat as a cement floor.
10	6	Sanitary.	2	1	Removed. One on account of swelling; one from swelling and shrinking.
11	7	Warm.	3	2	Unsanitary.
11	7	Dustless; clean.	2	1	Short life.
8	5	Easily cleaned.	2	1	Odor.
6	4	Resilient, pliable, shock absorber	2	1	Inflammable.
6	4	Easy on mules and horses.	2	1	Hard to keep clean.
6	4	Easy to move or set up machinery on, to put in pipes, etc.	1	1	Expensive to lay pipes under it.
4	2½	Save trucks.	1	1	Difficult to fasten machinery to floor.
4	2½	Non-inflammable.	1	1	Some blocks split.
5	3	Stands great abuse.	1	1	Wears rapidly where castings are thrown on floor.
4	2½	Dries quickly, waterproof.	2	1	Cut by steel borings and turnings.
3	2	Makes a solid floor.	1	1	Horses' calks catch in cracks between blocks.
3	2	Non-absorbent.	1	1	Ruts were worn, due probably to poor foundation.
2	1	Does not crack or chip when heavy castings are thrown on floor.	1	1	Sometimes men complain of its heating their feet.
2	1	Does not decay.	1	1	Pitch cushion expands and contracts.
2	1	Makes a neat floor.	1	1	Soils treads on tires in auto tire factory.
2	1	Keeps out flies, mosquitoes, etc.	1	1	Sand filler shakes down, causing roughness.
1	1	Not damaged by metal grinding into the floor.	1	1	Blocks float in brewery wash room.
1	1	Practical.	64	40	Did not reply.
1	1	Easily laid.			
19	12	Did not reply.			

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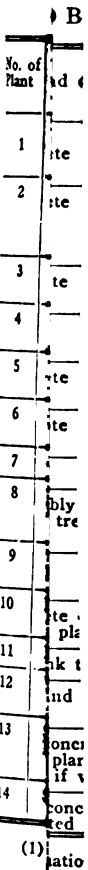

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or Wet Dry	C	REMARKS.
e	Swe	.....
	Flu	Does not wear as well as granite blocks. Cracks collect milk, etc., causing odor.
	Swe	Floor burned by hot castings causing repairs.
..	Scr	.....
he	Swe	.....
	"	Have other wood block floors recently installed.
ato er	"	.....
wet and dry	"	.....
nd dry	"hrinking.	.....
.....	.....	.....
end dry	Swe flu	Originally laid with cement filler which caused trouble. Relaid using tar and is now O. K.
	Swe ings are	.....
.....	"	.....
he	"	Has stood heavy trucking and hauling of heavy castings.
	"	A few blocks replaced where castings are dropped.
	"	.....
	"	.....
	"	.....
	"	.....
	"	.....
ate wet v	Flu	.....
he	Swe	.....
	"ng mills g in"	.....
.....	.....	.....
wet	Swe	None better for machine and boiler shop, etc.
n "	"	Satisfactory except for some swelling which necessitates repairs.
b	"	.....
eto the her	"	Have laid 5,000 sq. yds. since 1910.
n	"	Care should be taken in the selection of filler.
	"	.....

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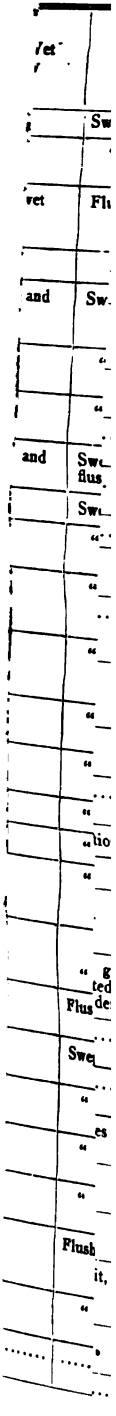

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			REMARKS.
	Swe		.....
	"	ounda-	.....
	Flu		.....
	"		.....
d	Swe		Never had a satisfactory floor for this service until wood block floor was tried.
	"		.....
	"	.....	Blocks shrink on sand cushion, because loose and were round.
d	Swe flush	.....	Very satisfactory.
	Swe		.....
	"	.....	Consider it ideal and will use them in all additions.
	"	.....	Will probably outwear plank or concrete.
	"		Warm, dry conditions caused shrinking. Floor was relaid after 4 mo nths.
	"		First laid with a 1" sand cushion which was not satisfactory and later changed to ½".
	"	.....	.....
	"	tion.	.....
	"		Blocks were wet when received. Floor had to be relaid after they had dried out.
	"	gives ked on dered.	.....
	Flush	.....	.....
	Swep	.....	We are laying treated wood blocks in all departments.
	"	es out	"We suggest a flexible asphalt filler and think even sawdust and oil joints would be better."
	"		.....
	"		The only satisfactory surface for shipping platform. Similar results from interior floors.
	Flush	it, etc.	Will prove expensive.
	"		Trouble probably due to foundation.
...	.....	.....	Used in ferry house.

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Wet / Dry	C	REMARKS.
.....	...	. Subjected to a heavy fire and only scarred 1/8" to 1/4". Fused iron burned in 1". Blocks scraped and used again.
	Sw	Satisfactory when well laid.
	"	Trouble experienced due to defective expansion joints.
	"	.....
	Sw flus	.....
	Swe	.....
	"	Consider it very satisfactory.
	"	Consider it very satisfactory.
	"	. Experienced slight swelling when blocks were accidentally wet.
	"	s .....
	"	.....
	"	.....
	"	.....
	"	.....
	"	.....
	"	.....
	"	Repaired on account of swelling.
	"	.....
	"	Should have used asphalt filler.
	"	Would not consider any other kind.
	"	Good quality blocks may be alright on solid base; sand cushion a detriment.
	"	. Consider creosote blocks the best floor possible.
	"	. Wore 3/4" deep in one place.
	"	ir Would use the same if rebuilding.
	"	. Swelling probably due to sprinkling floor.
	"	Unseasoned blocks caused shrinking.
to er	"	Prefer concrete on account of fire hazard.
	"	.....

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	Floor Wet or Dry		REMARKS.
	oth	.....	.....
	ry	at the irs.	Sand filler caused all the trouble. They think pitch filler would be satisfactory.
	pen to eather	aying.	.....
	oth		Repaired where moulds have been dropped.
	ry	.....	Only floor that would stand up.
		.....	Have used all kinds of floors but think creosote blocks are better in every way.
		.....	Best if properly laid.
		.....	This was an experiment, but is satisfactory.
		rred.)	Better than anything previously used.
		.....	Swelling due to leak in steam pipe.
96		.....	.....
97		.....	.....
98	.....	tennis	Failure and was removed.
99		.....	.....
100	ry	.....	.....
101		.....	.....
102	oth		.....
	ry		
103		.....	Laying an additional 3,000 yards.
104	.....	.....	.....
	.....		
105		.....	.....
106	ry		
		.....	.....
107	ry	swelling	Arched from swelling causing repairs.
	oth		
108			.....
109	Garage wet asement dry	.....	.....
110	ry	.....	.....
111		.....	.....
112		.....	.....
113			.....
114			Had trouble from swelling.
115		.....	.....
			.....

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t	How Cleaned	B i		REMARKS.
	Swept		are ma-	.....
	"			.....
	Flushed and swept		....	.....
	" "			.....
			sand	.....
	Swept			
	Flushed			.....
	Swept		....	.....
	"		tary.	Repairs due to shrinkage.
	"			50 sq. yds. laid on 1" sand cushion became uneven.
..	.....		....	Floor has not been in long enough to report on but indications appear satisfactory.
...	.....		....	.....
	Swept and flushed			.....
	Swept			.....
	"		....	.....
	"		....	.....
	Swept and flushed			.....
	Flushed		d to	.....
	Swept			½" to ¾" depression where steel is unloaded.
	"			.....
	"		and	.....
	"			Best floor they have tried.
	"		....	.....
	.....			.....
	.....		....	.....
	Swept		....	Are laying more.
	"		....	.....
	"			.....
	"			.....

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REMARKS.

	Recommend it highly.
	Cut down a few blocks.
	Just completed.
	Have great faith in it.

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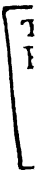

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also liable to cause uneven floors if the blocks shrink, and it seems likely that many cases of shrinking would not give serious trouble where bituminous filler and bituminous or cement grout cushions are used.

Bleeding caused very little trouble. In dry and very warm situations, where it is most likely to occur, it would be desirable to carefully consider the method of treating and handling the blocks in order to avoid objectionable bleeding.

In a few cases it seems likely that wood block should not be used. For example, it should not be used where butter or tobacco products are stored. In some foundries, where hot castings are thrown upon the floor, the blocks have burned through to the foundation. Wood blocks may be objectionable where the soiling or staining of certain classes of merchandise would lower the value, and in one case where used in a tennis court wood blocks were a failure and had to be removed.

Wood block was found to be very satisfactory in many cases where heavy castings are thrown about, where heavy trucks are moved, and is liked by workmen because it is warm and is easy on their feet.

The replies from the users of wood block flooring indicate quite strongly that when new wood block floors are to be laid, a careful investigation of all the conditions existing or likely to develop should be made by the manufacturer. The method of treatment and construction of the floor should then be adapted to the special conditions found. If this is not done many cases of dissatisfaction are very liable to develop.

THE PRESIDENT: This paper will be printed as information as Mr. Teesdale requested. Now, has anyone anything to say on this subject? I presume Mr. Teesdale is the only man who appreciates the work he has done to get these facts together and before this Association and the wood block men, and I am sure you do all appreciate the work and the information he has given you.

The next is the report of Standing Committee No. 3 on Wood Block Paving, Mr. Teesdale.

MR. C. H. TEESDALE: The Committee on Wood Block Paving was instructed last year to prepare a specification for this meeting. The instructions also stated that if possible the specification should conform with the one adopted by the American Society for Municipal Improvements. The specification proposed by their Committee on Wood Block Paving at their convention in October, 1914, was used as a basis from which we started. However, it was not adopted at their last convention and many changes have since been made in it. We thought it very desirable for the specifications of both associations to be as nearly the same as possible, and in order to do that we have taken the best

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parts of the specification which our Committee approved of and which in printed form you have in your hands now, and the best from the proposed specification of the American Society for Municipal Improvements, and we have drawn up this specification. It follows the old one quite closely in most respects, but I will have to read it to you, and I would suggest that you follow the old one and note where the changes have been made.

REPORT OF COMMITTEE ON WOOD BLOCK PAVING.

To the Members of the American Wood-Preservers' Association:

The Committee on Wood Block Paving was instructed to prepare a specification for the treatment and laying of creosoted wood blocks. The specification which this Committee has prepared does not contain a specification for the preservative, but covers the selection of the timber, its treatment, and the laying of the blocks in the street.

The Committee felt that insufficient information was available at the present time upon which to base a specification for the treatment of all of the species permitted. The specification, therefore, was made to cover only the treatment of southern yellow pine. We feel that it would probably be safe to follow this same specification for the treatment of Norway pine, hemlock, black gum, or tamarack, but it would probably not be a safe one to follow for Douglas fir. Further recommendations for the treatment of species other than southern yellow pine should be made by the Committee next year.

SPECIFICATION FOR CREOSOTED WOOD BLOCK PAVING*

Timber.

1. The wood to be treated shall be Southern yellow pine, Norway pine, Douglas fir, hemlock, black gum, or tamarack†, but only one kind of wood shall be specified in any one contract. The blocks must be sound, and must be well manufactured, square butted and square edged, free from unsound, loose or hollow knots, knot holes, worm holes, and other defects, such as shakes, checks, etc., that would be detrimental to the life of the blocks.

The number of annual rings in the 1 in., which begins 2 ins. from the pith of the block, shall not be less than six, measured radially, provided, however, that blocks containing between five and six rings

*This specification is intended for street work exposed to the weather. It is not intended to be used for flooring or inside work where the blocks are not exposed to the weather.

†All of these species have a legitimate field in street paving but it should be recognized that they are not equally durable.

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in this inch shall be accepted if they contain 33⅓% or more of summer-wood. In case the block does not contain the pith, the 1 in. to be used shall begin 1 in. away from the ring which is nearest to the heart of the block. The blocks in each charge shall contain an average of at least 80% of heartwood. No one block shall be accepted that contains less than 50% of heartwood.

Size of Blocks.

2. The blocks shall be from 5 to 10 ins. long, but should preferably average two times the depth; they shall be‡ in depth. They may be from 3 to 4 ins. in width, but in any one city block all of them shall be of uniform width. A variation of ⅛ in. shall be allowed in the depth and ⅛ in. in width of the blocks from that specified. In all cases the width shall be greater or less than the depth by at least ¼in.§

Preservative.

3. (Specified by Committee on Preservatives).

Treatment.*

4. The timber may be air seasoned, but should preferably be treated within three months from the time it is sawed. Green timber and seasoned timber shall not, however, be treated together in the same charge. The blocks shall be treated in an air-tight cylinder, with the preservative heretofore specified. In all cases, whether thoroughly air seasoned or green, they shall first be subjected to live steam at a temperature between 220° F. and 240° F.† for not less than two hours nor more than five hours, at the discretion of the treating plant operator, after which they shall be subjected to a vacuum of not less than 24 in., and held for at least 30 minutes.

While the vacuum is still on, the preservative oil heated to a temperature of between 180° F. and 220° F., shall be admitted, and the pressure gradually applied to the cylinder until a sufficient amount of the preservative oil has been forced into the block. §§ After this, if so desired,

‡The Committee recommends blocks 4 ins. in depth for very heavy traffic streets; blocks 3½ ins. in depth for moderate traffic streets. For light traffic streets blocks 3 ins. in depth may be used, but where 3-in. blocks are used no block shall be longer than 8 ins.

§This is very essential, to avoid laying some of the blocks on their sides.

*This treatment is recommended for yellow pine only. It is probably also suited to Norway pine, hemlock, black gum, and tamarack, but not for Douglas fir. Further recommendations on the treatment of these species are reserved for the future.

†In no case shall a steam pressure of 20 lbs. per square inch be exceeded.

§§The best results, so far as penetration is concerned, are obtained by using a low oil pressure maintained as long as possible before the required amount of oil is absorbed. High oil pressures and short pressure periods will give less complete penetrations.

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a supplemental vacuum, with or without steam,§ may be applied. In any given contract the blocks shall contain an average of not less than 16 lbs.§§ of water-free oil per cubic foot of wood at the completion of the treatment. Not more than 10% above nor 4% below the amount specified shall be allowed in a given charge. The blocks after treatment shall show satisfactory penetration of the preservative, and in all cases the oil must be diffused throughout the sapwood. To determine this at least 25 blocks shall be cut up from each charge, and if more than 4% of the blocks show untreated sapwood, the charge shall be retreated or rejected. After retreating, the charge shall be subjected to the same inspection.

The surface of the blocks after treatment shall be free from deposits of objectionable substances. All blocks that have been materially warped, checked or otherwise injured in the process of treating shall be rejected.

Handling Blocks After Treatment.

5. The blocks shall preferably be laid in the street as soon as possible after being treated. If they cannot be laid immediately, provision shall be made to prevent them from drying out by stacking in close piles and covering them, and, if possible, by sprinkling them thoroughly at intervals. In any case, where they are not laid as soon as they are received on the street, they shall be well sprinkled about two days before being laid under the direction of the purchaser. It is important to have the wood sufficiently wet to be swelled to its maximum size before it is laid.

Inspection.

6. All material herein specified and processes used in the manufacture of the blocks therefrom shall be subject to inspection, acceptance or rejection at the plant of the manufacturer, which shall be equipped with all the necessary gauges, appliances and facilities to enable the inspector to satisfy himself that the requirements of the specifications are fulfilled.

The purchaser shall have the further right to inspect the blocks after delivery upon the street for the purpose of rejecting any blocks that do not meet these specifications, except that the plant inspections shall be final with respect to the kind of wood, rings per inch, oil, and treatment.

---

§A steaming period for not over 30 minutes at a temperature of not to exceed 240° F. may be found useful in removing dirt, tarry matter, etc., from the surface of the blocks. This period may precede or follow the vacuum period at the discretion of the treating plant operator.

§§This amount may range between 16 and 18 lbs. per cubic foot at the discretion of the purchaser, the amount specified depending upon local conditions. More than 18 lbs. should not be specified.

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Foundation.

7. The base shall be of concrete made in accordance with the purchaser's specifications for concrete paving foundation, and shall be not less than 5 ins. in thickness*. At no place shall the surface of the finished concrete vary more than ½ in. from the given grade.

Cushion.

A—Mortar

8. Upon the concrete foundation shall be spread a layer of thoroughly mixed mortar made of one part of Portland cement of the character provided for in the foundation, and four parts of sand. Only sufficient water shall be added to this mixture to insure a proper setting of the cement, the intention being to produce a granular mixture which may be raked to the desired grade. The mortar shall be spread in place on the foundation immediately in advance of the laying of the blocks. The mortar bed shall be raked to the approximate grade and struck by templates to a surface parallel to the grade and contour of the finished pavement. The finished mortar bed shall have an average thickness of ¾ ins.

B—Bituminous†

9. Under special conditions, especially where vibration may be expected, mortar cushion may be omitted and a bituminous coating of one or two thicknesses spread upon a smoothly finished and thoroughly dry concrete base substituted therefor. In this case it is absolutely essential that the surface be smooth and true to form.

C—Without Cushion.

10. Blocks may be laid directly on the concrete base without providing a cushion. Great care must be used to have the surface very smooth and true to form, and thoroughly dry before the blocks are laid.

Laying the Blocks.

11. Upon the bed thus prepared the blocks shall be carefully set with the fiber of the wood vertical in straight parallel courses, leaving a space next to the curb for the expansion joint.‡

The blocks shall be laid by setting them hand tight on the base or cushion. No joint shall be more than ⅛ in. in width. They may be

*Under heavy traffic the concrete foundation should be 6 inches or more in thickness.

†The function of the bituminous cushion is chiefly in preventing absorption of water by the base of the blocks.

‡It is recommended that expansion joints should be ¾ in. in width at each curb for streets up to 30 ft. in width; 1 in. in width for streets between 30 and 50 ft. in width; and 1½ ins. in width for streets over 50 ft. in width.

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driven together about ten courses to keep the rows straight. Nothing but whole blocks shall be used except in starting a course or in such other cases as the purchaser may direct; and in no case shall the lap joint be less than 2 ins. Closures shall be carefully cut and trimmed by experienced men.

The angle of course to the curb shall be fixed at the discretion of the purchaser.

If the blocks are placed on a mortar bed they shall be rolled parallel and diagonally to the curb by a steam roller weighing between 4 and 7 tons until the surface becomes smooth, and is brought truly to the grade and contour of the finished pavement. The rolling shall be completed before the mortar bed has set. All mortar that has set before the blocks are in place and rolled shall be discarded and replaced by fresh mortar.

Filler.

12. After the rolling is completed the joints between the blocks shall be filled with a bituminous filler*. This shall preferably be done only when the temparature of the air is above 45° F. The filler shall be brought to the proper temperature and poured into the joints; and filler on the surface of the pavement must be spread as thinly as possible by means of squeegees. The filler shall be thoroughly worked into the joints between the blocks while hot, leaving no surplus on the pavement.

When the blocks are laid on streets having grades of 3% or over, it is desirable that the blocks be spaced by laying creosoted wood lath about $\frac{1}{8}$ in. thick between each course. The space above the lath shall then be filled with crushed stone containing no dust and bituminous filler. The bituminous filler shall first be poured into the bottom of the joint, care being taken to get none on the surface of the pavement. The crushed stone† shall then be swept into the joint, and the space around the stone filled with the bituminous filler to the top of the joint. It is essential in open joint pavement to drive the blocks together every four rows to prevent tipping of the individual blocks.

After inspection by the purchaser the surface shall be completely covered to a depth of about ½ in. with clean, coarse, dry sand. This sand is to be left upon the pavement until such time as the purchaser may direct, when it shall be removed by the contractor.

Thermometers in Kettles.—The kettles in which the filler is heated

*Specifications for filler will be prepared later. Either coal-tar pitch or asphaltic fillers may be used.

†It is very important to have the crushed stone heated so that the filler will penetrate around them and make a solidly filled joint. If possible the stone should be heated to 350° F. before being applied. This may be done in the sand drum of an asphalt plant.

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on the street shall be equipped with approved thermometers, and the pitch shall be heated to a temperature of not less than 255° F. nor more than 300° F., and shall be poured when at a temperature between these limits.

NOTE: Engineers should not use this specification as a whole, but should make a selection of material and method where more than one is indicated under the different headings.

C. H. TEESDALE, *Chairman.*
F. W. CHERRINGTON,
H. M. NEWTON,
H. S. LOUD,
F. P. HAMILTON.

MR. C. H. TEESDALE: The Committee recommends that this specification be adopted by the Association.

THE PRESIDENT: Now, gentlemen, you have heard the Committee's report. If you jump on Mr. Teesdale too hard, I am going to call on Mr. Buehler, of Committee No. 7 here. If you are easy on him perhaps he can handle it all right. Gentlemen, what is your pleasure?

MR. J. C. WILLIAMS: Mr. President, I would like to emphasize the fact that the report as Mr. Teesdale read it is somewhat different in several important particulars from the printed report, and I hope that any member that finds need of using these specifications will wait until the Proceedings are published and get the final report. I intended to call attention to two or three points in the Committee report, but Mr. Teesdale "spiked my guns" by amending the report. The only thing I have to say now is about the percentage of sap that is allowed. The Committee has limited it to 50%.

I wish there were some timbermen, some fellows who saw the planks, who could talk about that point. It seems to me that if you take 50% of the sap in an individual block, you can take 60 or 75. If it is going to wear on account of sap it will fail with 50% the same as it would if it had a hundred. Otherwise than that I consider that would be a specification that could be adopted by this Association as standard practice. It gives the City Engineer quite a range of choice as to his cushions and foundation and incline to the curb and so forth, and is not restrictive. That is the type of specification that can be sent broadcast throughout the United States from the Pacific to the Atlantic and from the Gulf to the Great Lakes, and somebody will find something in there that he can use and be benefitted by and be satisfied with after the job is done.

MR. L. I. PARMINTER: Mr. President, from a lumber stand-

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point, I see no objection to that specification, except that it seems to be above the average amount of sap. The minimum is 50%. I would like to ask the Chairman of this Committee what his version of that specification would be in regard to the average amount of sap allowed. I also think any specification for the treatment of blocks should show some degree of penetration. This specification says a "satisfactory" penetration. That is indeterminate. It might be 40% of the volume of the wood or 80% or 90%. I believe that any specification adopted by this Association should show some degree of penetration. I would like to hear Mr. Teesdale's views.

MR. C. H. TEESDALE: There is a sentence restricting the average amount of sapwood to 20%. I will read what it says:

> The blocks in each charge shall contain an average of at least 80% of heartwood, but no one block shall be accepted that contains less than 50% of heartwood.
>
> The blocks after treatment shall show a satisfactory penetration of the preservative and in all cases the oil must be diffused throughout the sapwood. To determine that cut up 25 blocks, and if one of those 25 blocks shows a sap penetration—

MR. L. I. PARMINTER: What determines the amount?

MR. C. H. TEESDALE: Thoroughly diffused throughout the sample. A satisfactory penetration of heartwood is the way it reads.

MR. L. I. PARMINTER: That is, throughout the heartwood also?

MR. C. H. TEESDALE: Throughout the sample.

MR. L. I. PARMINTER: I would say I know the practice in the South, in treating most of the blocks down there, is to require practically an 85% or 90% penetration, and they are getting it. It seems to me that 16 or 18 lbs. of oil would be easily gotten into a three or three and one-half cross-section, and the fact of the block having gone through a retort (showing only 30% or 40% of the wood treated) does not make it a good block according to my idea.

MR. C. H. TEESDALE: The specification does not say that. It says it shall show a satisfactory penetration.

MR. L. I. PARMINTER: Well, in actual practice you can find on the street many blocks which do not show more than 30% or 40% of the volume of wood penetrated. It would seem to me that a specification of this kind should cover that point.

MR. H. M. NEWTON: Mr. Chairman, I should like to ask Mr. Parminter just how they determine whether they have 80% or 90% penetration. Do you figure the black area on a cross-section of each block examined, or do you cut blocks and say: "This is white," putting that in one pile, cut a few more and finding them all black put them in another pile, and then if 85% of the blocks cut are thoroughly black

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conclude that you have 85% penetration? If not, just how do you determine percentage of penetration?

MR. L. I. PARMINTER: Why, the inspectors I have seen in operation take a number of blocks, eight or ten blocks, and cut them and if those blocks do not show approximately 85% or 90% of penetration the charge goes back into the cylinder.

MR. H. M. NEWTON: That is just exactly what I want to find out, Mr. Parminter. How do they know after cutting say 10 blocks whether they have 85% penetration or 75% penetration?

MR. L. I. PARMINTER: Well, that would be pretty hard to tell, but it is not so hard to tell whether they have 85% or 45%.

MR. H. M. NEWTON: How do you know when you have 45%? Would it be by general appearance, or on what would you base it?

MR. L. I. PARMINTER: I would say the general appearance. The block, probably half of it, would not be treated.

MR. H. M. NEWTON: As I understand it then, you would take a cross-section of each one and examine it and say, "Here is a cross-section, four by four, and about half of that area is white and half is black."

MR. L. I. PARMINTER: Yes.

MR. H. M. NEWTON: And rate that block 50%?

MR. L. I. PARMINTER: I would say that half of the volume of the wood, not half the area; half the volume of that wood when treated would have to be black.

MR. H. M. NEWTON: Now, I might say this, that I think that would be very well if it could be done. We in this section of the country have never been required to judge penetration on a percentage basis. To be sure a number of the blocks are usually split up and if more than a negligible percentage are white, why, you are likely to hear a loud complaint. On the other hand, if the inspector is satisfied that he is getting 16 lbs. when the specification calls for 16 lbs., the blocks probably will be accepted and it would, in fact, be very difficult for the inspector to refuse them. I agree with Mr. Parminter that the expression "satisfactory penetration" is not a good expression. It may be worked to the detriment of the purchaser or it may be worked to the detriment of the manufacturer. An engineer may change his specification from what was formerly a 20-lb. treatment to a 12-lb. treatment. The only change he makes in the specification is to cross out the figure 20 and put in the figure 12. He will often leave the other requirements as they were; such as that the blocks required should show a thorough penetration throughout.

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Inasmuch as the method of treatment is set forth fully it is often impossible to secure a thorough penetration or as thorough a penetration on 12 lbs. as it is on 20. Now, this Committee in view of those facts and in view of what we have learned here in the last year about sapwood rotting when not treated, tried to cover that point by not only specifying that the penetration should be satisfactory, but we tried to find a way in which to judge whether the penetration was satisfactory or not. In the examples shown by Dr. von Schrenk we have very few cases, if any, where the heartwood rotted.

The trouble seems to be in the sapwood. The moisture is left in the sapwood, and then the oil forced in in a sort of hurry-up treatment where time is the main element, and the water is left in the sapwood with a little block of oil in each end, and we have results as shown here. We have tried to eliminate that by the method of treatment, and also by the further requirement that after a charge is treated at least 25 blocks be split, and that if more than one of those 25 blocks shows white sapwood, the charge must be re-treated.

The fact that more than one block shows white sapwood does not necessarily prove that the charge does not contain an average of 16 lbs. of oil to the cubic foot. It proves only that the charge was improperty treated, or the wood was improperly prepared before the creosote was injected. To remedy that situation before the blocks are put on the street we provide for a re-treatment of that charge. I personally believe that such a requirement is better safeguard against improper treatment than any statement as to what percentage of penetration should be obtained.

THE PRESIDENT: Who is the next man?

MR. AUGUST MEYER: I notice in the specification the Committee has left out hard maple. I would like to ask if there is any objection to this kind of wood. If there is, I would like to know what it is.

THE PRESIDENT: Mr. Teesdale will take notes and answer these questions after the members of the convention are through discussing the report. I understand the paper Mr. Teesdale prepared he has thrown into the waste basket, and this is a new paper entirely.

MR. A. E. LARKIN: Now, when you consider the question preparatory to voting on it please remember that the motion before you is designed to simply accept the Committee's report with thanks as information, and to be handed on to next year's Committee, with the request that they do additional work on it.

I am very sincere in requesting your careful consideration of this motion, because I know you do not want to make any mistake in a

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matter of this kind, and that you will feel perfectly sure that another year's work on this report will, no doubt, improve it. I call for the question.

I wish to call to your attention to a few points with reference to this report.

In the first place, a specification of this kind should not be adopted by this Association until it includes a preservative. It would be very inconsistent to hand a wood block specification to an engineer in which nothing is said about the preservative.

In another way it is incomplete, because the Committee has not taken up in any way one of the difficulties encountered in the construction of wood block pavements on a street where street railway tracks are included. It is very important that the manufacturers and the engineers interested in constructing wood block pavements know how to specify and build a successful pavement on a street where there are one or more street railway tracks. This is a detail which should be taken up and fully covered by a report of this kind before we are asked to adopt it as a standard.

It was difficult to get the Committee's idea with reference to storing paving blocks on the street, but the impression conveyed was that they expect trouble from expansion and contraction, and expect to eliminate it by wetting the blocks down if they cannot be put in place in the pavement immediately upon delivery upon the street.

This surely cannot be their recommendation to eliminate expansion and contraction troubles in the pavement after the blocks have finally been put in place and the pavement complete. If the blocks will dry and subsequently absorb water and expand while they are loosely piled on the street, is it not reasonable to suppose they will continue to do exactly the same thing after they are in the pavement, except perhaps not so rapidly, and thereby result in failure of the pavement? Surely a specification covering work of this kind should go into the matter of buckling pavements and show how to eliminate them, rather than to specify remedies for the effect, and not the cause of failures due to expansion.

This specification should also carry our best recommendation with reference to the concrete foundation. You know any surface material that is used over a base that for any reason fails always carries the blame for the failure.

The Committee should go into the matter of foundation very carefully, specifying the ingredients and outlining best practice with reference to placing the foundation.

The engineer may be perfectly competent to specify the right kind

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of a foundation. On the other hand, he may not, and while we only suggest that the engineer use certain parts of this specification, yet we ought to give them to him complete and containing our very best experience on the foundation problem, which is a big one.

From the standpoint of construction you can hardly separate the foundation problem from the cushion problem. Two different cushions have been mentioned in the report, mortar and bituminous, nothing said about sand cushion. The mortar cushion is given greatest emphasis.

Now, we know that up to the present time most of the wood blocks in the United States have been laid on a sand cushion, and, generally speaking, creosoted wood pavements have been satisfactory. I am not prepared to say that a mortar cushion is not the best cushion. We do know that it increases the cost very materially, and whether we get correspondingly better results or not is a question that has not yet been demonstrated.

The bituminous cushion proposition has certainly not received proper consideration. It is a question whether the method proposed of laying blocks with bituminous cushion is entirely practical, except in very unusual conditions, such as waterproofing bridge decks, for instance.

As I have stated, the foundation and cushion problems, from the construction standpoint, are very close together. There is a method being widely used that the Committee should consider carefully.

This method calls for the use of a template constructed to ride on the curbs, and used to determine the grade and contour of the finished pavement, using the same template first for the grading, then for the concrete, and finally for the cushion. The template so constructed as to be adjustable for the different elevations required, when this method is used the best results are then obtained. When the surface is then rolled you are assured of a uniform thickness of base and a uniform thickness of cushion, which is very essential. This method is also less expensive when used between street intersections, because it does away with setting grade stakes after the curbs are set.

This report does not properly cover the very important matter of filler. No specification is submitted covering this material, but something was read covering the temperature the filler should be delivered at on the street. Well, you cannot separate the matter of the temperature of these fillers from their specification, so how can we attempt to adopt the specification that tells us of the temperature we should use in handling a pitch filler without having before us a specification covering the essentials of the filler.

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I make a motion that this Committee be thanked very kindly for the work they have done; they have given us some very good suggestions, and that the report be accepted as information and passed on to the next year's Committee.

THE PRESIDENT: Is there a second to that motion?

MR. L. I. PARMINTER: I second the motion.

MR. M. SCHUYLER: Just a word about the foundations. I agree with the previous speaker that it is very inadvisable to make mention at all regarding the foundation. A foundation of 5 in., or 4 in., or even 3 in., is good enough in some places, and, again, a foundation of even 9 in. thick would be sufficient on other soils. In Cleveland they lay bricks in some sections of the city without any concrete foundation at all, and brick incidentally suffers more from foundation failures than any other type of pavement. So I think that it is inadvisable to specify any particular thickness. That should be left entirely to the judgment of the engineer, who should base the thickness of his concrete foundation, not upon the recommendation of a general committte, but upon his own study of local soils.

MR. WALTER BUEHLER: I believe that mention should be made in this specification as to the limits of the crown at which the pavement is to be laid. We sometimes hear a criticism that the creosote block pavement is very slippery, and investigation in some cases has resulted in finding that the crown at which the street was laid was excessive. I know of one particular case where a street was very slippery, and, in fact, in this particular town, due to the slipperiness of this street, the creosote block pavement got a black eye. Of course, the general public in going over a street never analyzes the reasons; they see results only. This street was paved, and has a 46-ft. roadway, with a 14-in crown. The intersecting streets were on a heavy grade, and this same crown, in a good many cases, was carried across the intersection. You can imagine the result.

MR. W. H. FULWEILER: Mr. Chairman, there is one situation that I have noticed in watching wood block pavement, particularly in a certain town in the East, that I think would be worthy of some committee's attention, and that is the question of getting together with the street railway companies or their associations to solve the crossing or intersection problem. In this city I speak of on many of the important intersections in the business part of town where they have wood blocks they have removed the wood blocks and replaced them with granite. I do not know whether it is within the province of our Committee to take up that particular problem or not, but it does seem to me that it is the problem that becomes quite serious at times, and is certainly worthy of considerable thought.

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MR. A. L. KUEHN: Mr. President, this specification states that all blocks shall be steamed. Now, I gather from previous work by Mr. Teesdale that the principal idea in that is to prevent bleeding. I do not believe that enough evidence has been furnished to prove that this steaming will stop the bleeding, at least not enough to put it in a standard specification.

THE PRESIDENT: Once or twice in our conventions we have had a man here from Chicago. I do not know whether there is anybody here now, but we have had commissioners here who have given us good talks on blocks. We will recognize anybody who wants to discuss this question.

MR. WALTER BUEHLER: I was going to suggest that the Chair call on Mr. Gabelman. I do not believe he will get up unless you call on him. I know that he has been a very close observer along these particular lines, and I think the Association would benefit by what he would have to say.

THE PRESIDENT: Will Mr. Gabelman come up here so that the stenographer can get his remarks?

MR. JULIUS GABELMAN: Mr. President and gentlemen: I want to say that the gentleman from the North flatters me when he says that I am a very close observer, and when he placed me in the class with commissioners. I do not know whether I can live up to that. I want to mention one thing that might be of importance, and that is to get proper drainage. That is very important on a creosote pavement. I believe the matter of crowns has been overlooked in a great many cases. I wish to emphasize what Mr. Buehler has said in regard to crowns. I believe in putting plenty of catch basins along the line of work, so that the pavement will be quickly drained. Another matter that has occurred to me is that along the brow on car-track streets a little extra pitch should be given, to get the water away from the tracks quickly. If water gets into the joints along the rail the vibration displaces the cushion, and the surface of the pavement becomes uneven. When blocks in the depressions are taken up it is generally found that they are full sized, the trouble being due to the displacement of the cushion underneath.

As to the fillers, I do not know that I am prepared to say much on that line. I did not hear all this paper. I came in rather late, and I am sorry that I did not hear it all.

About penetration, I believe the inspector using good common sense could see that the blocks are properly penetrated.

In the matter of foundation, I think proper attention should be given to getting it properly laid, so as to support the pavement.

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In the matter of sand cushion,, which has been mentioned, I think torpedo sand or limestone screenings, where they are available, are good enough for a cushion on residence streets, or any street where there are no car tracks. It may be different on streets where there are car tracks, where there is vibration.

In the matter of preservative, of course I would not want to touch on that (laughter). I think that can be ably handled any way at this meeting by those better qualified to speak on it than myself.

THE PRESIDENT: Mr. Card, have you anything to say on this question?

MR. J. B. CARD: No.

THE PRESIDENT: Is there anyone else?

MR. FRANK W. CHERRINGTON: Mr. President, I would like to answer a question Mr. Kuehn brought up in regard to the steaming of the blocks. We find in our practice that the steaming of the blocks not only tends to retard the bleeding of the oil to the surface of the pavement, but it also equalizes the moisture content of the blocks, no matter whether the blocks are air-seasoned or green, steaming equalizes the moisture content and provides a more uniform resistance to the penetration of the preservative. Uniformity of penetration is an important requirement to consider, and steaming blocks before treatment, in our opinion, helps to accomplish this result. If air-seasoned blocks are used, and not first steamed, a good many of the blocks are more susceptible to rapid absorption of the preservative than others. By equalizing the moisture content you provide a more uniform penetration.

THE PRESIDENT: Is there anyone else who wants to speak on this subject?

MR. N. C. BROWN: Mr. President, I would like to ask if the reference to tamarack includes Western tamarack? I know in the Western section tamarack has been used to some extent in the so-called Inland Empire, and is considered a very desirable wood to serve as a block pavement. I perhaps had better put that in the form of a question whether the Committee included both Eastern and Western tamarack?

MR. C. H. TEESDALE: It is meant to be Eastern tamarack, but I do not believe the Committee would have any objection to including Western larch.

MR. N. C. BROWN: Have you made any studies on the Western tamarack?

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MR. C. H. TEESDALE: In the Minneapolis experimental pavement it has not lasted as well as some of the other species.

MR. N. C. BROWN: And that is the reason you left it off?

MR. C. H. TEESDALE: Yes.

MR. N. C. BROWN: I understand it is giving very good satisfaction in the Spokane country.

MR. C. H. TEESDALE: I have seen Western larch pavements in Spokane, Wash., that appeared to be in fine condition after four and five years of service.

THE PRESIDENT: Now, Mr. Teesdale, will you answer some of the questions?

MR. C. H. TEESDALE: Mr. President, I would like to have the opportunity to consult with the Committee before answering these points.

THE PRESIDENT: There is a motion before the house. Do you want us to hold that up?

MR. C. H. TEESDALE: Yes.

THE PRESIDENT: If it is satisfactory to the convention we will pass to Mr. Larkin's Committee, and this Committee can retire and come back after we are through with Mr. Larkin's report. Is that satisfactory to you, Mr. Larkin?

MR. A. E. LARKIN: Yes.

THE PRESIDENT: We will now have the report of the Committee on Service Tests of Wood Block Paving.

MR. A. E. LARKIN: Our President, Mr. Waterman, has a delightful hobby. His hobby, which he has exercised for the benefit of the members of the American Wood-Preservers' Association this past year, is "Facts." Two committees, at least, were appointed during his administration that were prompted by his love for facts. One of them was Committee No. 5, that received his instructions to get service tests and facts on railroad cross ties, and the other, Committee No. 6, to report the facts relating to wood block pavements that had seen service.

The delightful thing about President Waterman's hobby is that whether the facts are for or against us he insists on having them. This is a characteristic of his, and is a valuable asset to the Association, and the wood-preserving industry as a whole, because often the careful analysis of a failure is more important and a better teacher than an analysis of a success. He is, therefore, perfectly logical when he insists that facts concerning railroad tie and pavement fail-

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ures should be brought out into the open as well as the facts about the successful work.

Considering the personnel of Committee No. 6 from the standpoint of their geographical location the Chairman attempted to secure a report from each member on a pavement constructed and used in the city where he resided. The Committee report then to be combined from the reports of the members.

The members of Committee No. 6 are distributed throughout the United States as follows: Mr. Manley is located at New Orleans, La.; Mr. Beal at Seattle, Wash.; Mr. Draper at Newark, N. J.; Mr. Moses at St. Louis, Mo., and the Chairman at Minneapolis, Minn. We could have shown interesting results about different pavements under several different climatic conditions, as well as differences in manufacture and construction if we had been successful in getting a report from each member.

We secured, however, three reports, one each from the cities of Newark, N. J.; Seattle, Wash., and Minneapolis, Minn. The reports follow, each one confined to a single street. The accompanying photographs will help to show actual conditions at the time the reports were made.

REPORT OF COMMITTEE ON SERVICE TESTS OF WOOD BLOCK PAVING.

To the Members of the American Wood-Preservers' Association:

In April, 1909, the Metropolitan Building Co., of Seattle, Wash., improved Fourth Avenue for a distance of two blocks with creosoted wood block pavement. This district is entirely an office section, and it was the purpose of the Building Co. to place a pavement along their office buildings, which would be sightly, quiet, and have other desirable properties, considering the location. The grade is 3.92%. The sub-base is firm ground, more or less of a hard-pan nature. The concrete foundation is 6 ins. thick, composed of one part cement, three parts sand and six parts gravel. The blocks are bedded on a cushion 1 in. thick, composed of one part cement, three parts sand.

The cushion was spread damp, and the blocks laid directly thereon and rolled to grade. One-inch expansion joints were left along each curb and filled with blue clay. The blocks were 3"x8"-4" deep. Three courses of blocks were laid parallel to the curb, adjacent to the expansion joint.

The blocks in the roadway and on the car tracks' right of way were laid in courses at right angles to the center line of the street.

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The joints were filled with fine hot sand swept in, and the entire surface was coated with coal-tar pitch, which filled the upper portion of the joints. The street is 50 ft. wide, and has a crown of 7 ins. The blocks are reported to have retained 12 lbs. of oil per cubic foot. This street contains 3,678 sq. yds. of pavement. The blocks were thoroughly penetrated through and through, and no difficulty was experienced due to expansion.

The blocks show a wear at the present time of ⅛ in. The amount of depressions due to shifting of the cushion will not exceed one per

Fourth Avenue, Seattle, Washington.

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cent. The surface of the street has worn uniformly, and outside of the small portion under which cushion has shifted is in perfect condition.

The accompanying photograph was taken about three months ago, and shows the alignment of the blocks along the car track; also the general condition of the street. The pavement was over six years old when the above records were made. There has been no maintenance cost on the portion of pavement controlled by the city. Slight trouble was experienced last winter at the foot of the slope between the car tracks. This trouble came from clogging up of drainage and the lack of provision for drainage at the lowest point on the grade. Water which found its way down under the blocks at car rail joints worked to the bottom of the slope, and had no outlet, which caused the trouble. The trouble was very small, and expense of making repairs was practicable negligible. The difficulty was in no way the fault of the blocks, and was entirely due to lack of provision for drainage.

The creosote oil used in treating the blocks is reported to have been an English oil of approximately 1.045 specific gravity. No decay whatever is present in the blocks, and the street looks as if it would be good for many years' service without repair.

Pavement on South 14th St., Central Ave., to Orange St., Newark, N. J.
(August, 1909, to October, 1915.)

This street has a double car track in the center, the pavement on each side of the car track being 11 ft. wide, of creosoted wood block. It was laid in the summer of 1909, the pavement being completed on Aug. 30, 1909. It was, for a number of years, the only paved crosstown street in the vicinity, and had very heavy traffic. The traffic at present is not as heavy as it was, but it is still one of the principal thoroughfares for crosstown traffic.

It was laid on a 6-in. concrete foundation, mixed in 1-3-6 proportions, with a ½-in. mortar top cushion, of one part cement to four parts sand.

The blocks were of Southern yellow pine, 3½ ins. deep, 4 ins. wide and from 6 to 10 ins. long. They were treated with 20 lbs. of creosote oil per cubic foot, the specification of creosote oil being as follows:

> Gravity not less than 1.10 at 25° C. To be pure coal-tar product, free from any product obtained from petroleum, and shall not contain more than 5% of matter insoluble in benzole; distillation to be as follows:
>
> | | |
> |---|---|
> | Up to 150° C..... | 0 |
> | " " 210° C. not more than | 10% |
> | " " 235° C. " " " | 20% |
> | " " 315° C. " " " | 35% |
> | " " 370° C. " " " | 50% |

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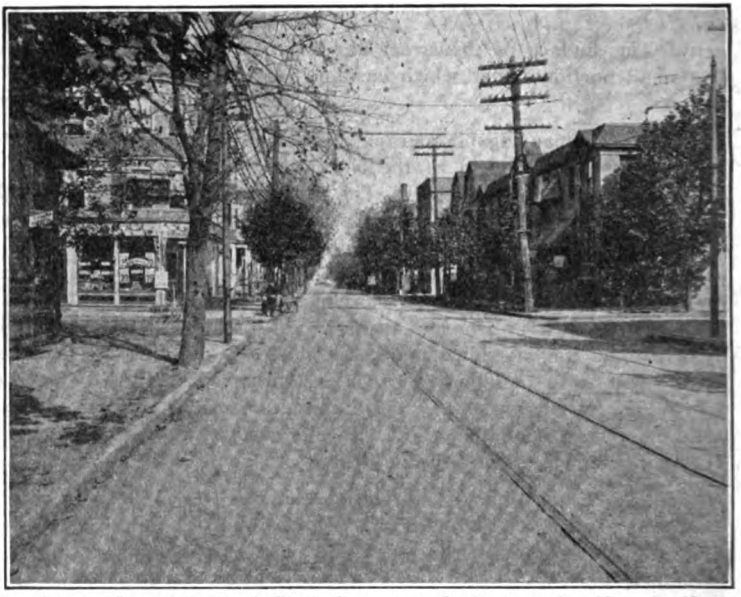

FIG. 1—Creosoted Wood Block Pavement, South 14th St., Newark, N. J. (Pavement Completed August, 1909. Photo taken October 28, 1915.)

FIG. 2—Creosoted Wood Block Pavement, South 14th St., Newark, N. J. Surface after 6 years' wear. (Close view at same position as Fig. 1.)

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The blocks were laid with as tight joints as possible, with ½-in. expansion joints along curb. The joints were filled with cement grout, composed of two parts clean sand and one part Portland cement, mixed to a perfectly liquid form, and joints swept until completely filled. The surface was then covered with ½-in. of screened sand.

The pavement at present is in perfect condition, no repairs having been made, and there being no evidence of any appreciable wear. The average wear of the blocks would not be over ⅛ in. The view shown of the surface in photo gives a very good idea of the perfect condition of the pavement at present, the uniformity of the surface and the lack of any signs of wear.

Creosoted Wood Block Pavement, 10th St., From Marquette Ave., to Park Ave., Minneapolis. (1902-1915.)

This pavement was laid in 1902 by the City of Minneapolis Paving Department, and was the first creosoted wood block pavement constructed in that city.

It embraces 13,305 sq. yds. of 4-in. Southern yellow pine blocks treated with 12 lbs. of a pure distillate creosote oil obtained wholly from coal-tar, and having a specific gravity of approximately 1.08.

The blocks were laid on a 6-in concrete base, with a 1 in. sand cushion and pitch filler.

The pavement, at the present writing, has just completed its thirteenth year, and is in a remarkable state of preservation and repair, speaking highly for the wearing qualities of Southern yellow pine and the preservative qualities of pure coal-tar creosote. The street has, from the first, sustained a heavy crosstown traffic, and today its surface is uniformly smooth and entirely free from chuck holes or any sign of deterioration. In fact, it is in much better shape than some of the pavements laid during the next few succeeding years where woods of mixed species and lower grade oils were used, tending further to show that the ultimate life of these pavements is dependent on the quality of material used.

During the year 1915 the first repairs were made by the city, which consisted only of replacing a few blocks showing defects. The cost of this work was so slight that no record was made of same. It is stated, however, by the Engineering Department that the total cost of repair and maintenance of this pavement for the past 13 years is estimated to be not more than 0.1 cent per square yard, or, in other words, less than $14.00. This is, of course, exclusive of the cost of repairing openings made in the street on account of the sewer and water connections.

The accompanying photographs show conditions as they exist at

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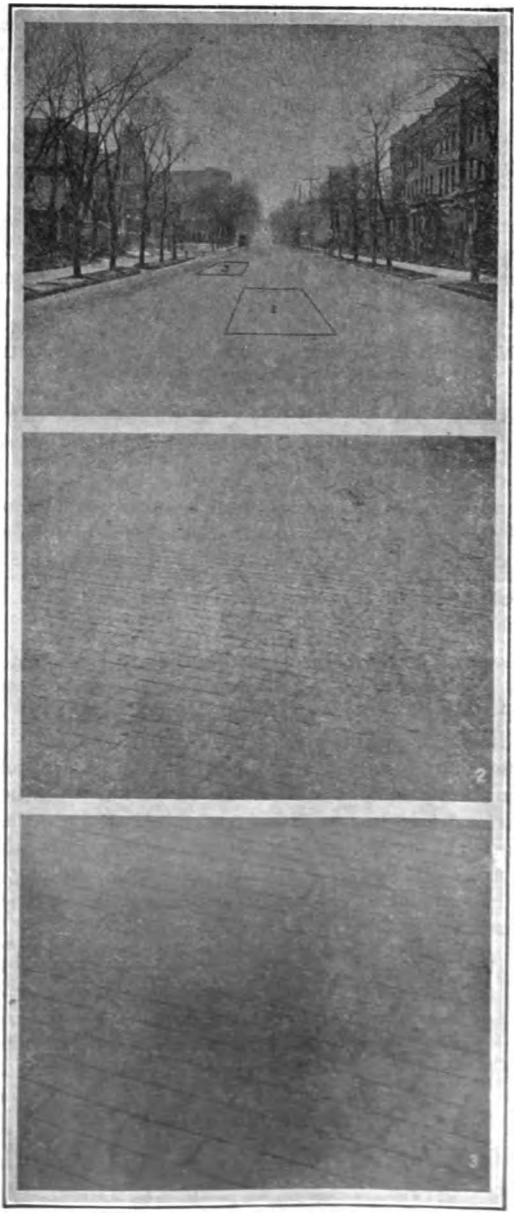

Creosoted Wood Block Pavement, 10th St., Minneapolis, Minn.
(Looking West from 8th Avenue.)

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the present time. Fig. 1 shows Tenth Street looking westward from Sixth Avenue south. The uniform smoothness of this surface is to be noted.

Fig. 2 shows in detail the appearance of the pavement near the center of the street about 150 ft. west of Sixth Avenue south, as indicated on Fig. 1.

Fig. 3 shows similar details of the pavement at a point 250 ft. west of Sixth Avenue south, taken also near the center of the street, as indicated on Fig. 1. Note the knitting or brooming of the joints and total absence of cobbling. Both Figs. 2 and 3 are representative of the average condition of the entire surface near the center of the street where the traffic has been most severe. Except for the middle third of the street, the blocks appear practically as originally laid, both smooth, sound and well jointed.

Figs. 4, 5, 6 and 7 are views of some of the blocks taken out of the pavement Nov. 18, 1915, for examination, as compared with a new creosoted block of full 4-in. depth. As seen from the scale placed beside these blocks in the photograph, the wear varies from .05 in. to .30 in. From an average of the depth of all blocks taken from near the center of the street we conclude that the average maximum wear on the heavily-travelled portion of the pavement is approximately .25 in.

It is also notable from the photographs of the blocks that the fiber has retained the oil with which they were originally treated, showing both the thoroughness of the original treatment and the stability of the material used. The pavement has neither "bled" nor buckled.

From all data obtained at this time it would be impossible to show that more than 10 or 15% of the efficiency of the pavement has been expended. This piece of wood block paving has for some years attracted the attention of engineers in the Middle West, and has justified, to a large extent, the adoption of wood blocks on a large scale in this section of the country.

Conclusion.

Please note that the Committee report is confined to a brief statement of facts concerning each pavement, which was the instructions received, and upon which the work of the Committee was based.

The Committee respectfully suggest that this work be continued along similar lines another year, and that they secure, wherever possible, accurate service tests on the oldest pavements available.

The next Committee, however, should not confine their analysis and investigations to the successful pavements alone, but to pavements that have failed and been either altogether or partly unsuccess-

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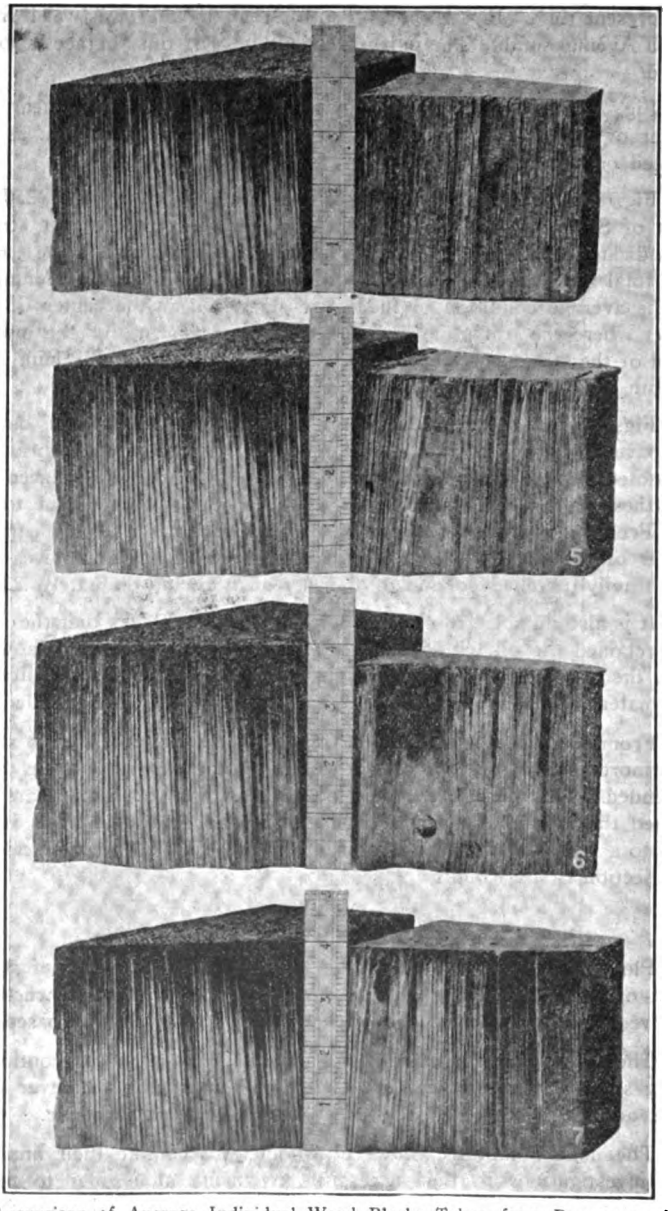

Comparison of Average Individual Wood Blocks Taken from Pavement with a New Block of Original Depth.

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ful as well. This procedure will help perpetuate the policy of President Waterman, which policy has a great deal of merit because of its educational value.

If the work of Committee No. 6 is continued along this line the result will be the collection of considerable data that can be examined and used to good advantage. While new pavements should be selected each year to report on, yet care should be taken to keep preceding reports up to date, in order that all the work of the Committee on Service Tests of Wood Block Paving would always be available and current.

Report respectfully submitted:

A. E. LARKIN, *Chairman.*
L. B. MOSES
R. S. MANLEY
E. G. DRAPER
F. D. BEAL

THE PRESIDENT: You have heard the recommendation of the Committee. Will someone make a motion?

MR. C. N. FORREST: I make a motion to accept the report and continue the Committee with thanks.

THE PRESIDENT: Is there a second to the motion?

MR. J. H. CAMPBELL: I second the motion.

THE PRESIDENT: Now, we are ready to discuss it.

MR. L. T. ERICSON: Mr. President, in connection with the report which Mr. Larkin made with reference to South Fourteenth Street, Newark, there is only one observation I would like to make. I made that examination for Mr. Draper. I found that there was a considerable number of blocks in that street which were wider than ordinarily permitted in specifications for paving. There were a whole lot of blocks in that street with only four or five rings per inch, and I could not notice that there was any difference in the wear of those coarse, wide growth blocks over the very fine grained ones.

THE PRESIDENT: Has anyone else anything to say on this subject? In other words, has anyone else any more facts? If not, are you ready for the question?

MR. WALTER BUEHLER: Just as a matter of interesting information. About three years ago the City Engineer of Minneapolis prepared a statement showing the total yardage of creosote blocks laid in the city, its cost and the maintenance cost. It has been some time since I have seen this statement, so I am speaking from memory only.

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but as I recall it at that time, there were something like 69 miles of creosoted block pavement in the city, something over 1,000,000 square yards, which was put in at a cost in round figures of about $3,000,000. The average life of the pavement at that time was about seven years. The oldest was laid in 1902, and this statement was made three years ago. They were putting in from about 150,000 to 175,000 yards a year. The interesting point is that the total maintenance cost at that time was less than $700. When you figure an expenditure of over $3,000,000 for a period of an average life of say seven years, with a maintenance cost of less than $700, it is a remarkable showing for this pavement.

THE PRESIDENT: Has anyone else anything to say? Are you ready for the question? The motion is that the report be accepted and the Committee continued. Those in favor say Aye, opposed No. The Ayes have it. It is so ordered.

The Committee, No. 3, on Wood Block Paving, Mr. Teesdale, want to make a statement.

MR. C. H. TEESDALE: The Committee would like very much to have further action on this report deferred until tomorrow, and if Mr. Larkin will be so kind as to withdraw his motion, I would like to make another motion that the action on this report be taken tomorrow instead of today.

THE PRESIDENT: Mr. Larkin, have you any objection to deferring action on that report until tomorrow morning?

MR. A. E. LARKIN: Well, I feel this way about it. We have heard a great many members of this Association discuss the report, and everyone of them has brought up several very good points that should be considered before a report of this kind is adopted. The very fact that the report is not before us, that we cannot analyze it carefully is sufficient to show that we certainly cannot intelligently adopt it as a standard at this time. There is every indication that the Association is not ready to adopt it.

There seems to be only one thing we can do with the report under the circumstances, and that is to simply accept it as information, and pass it on for the use of the next Committee. I am not in favor of putting this over until tomorrow. We have a very busy day ahead of us, with other matters to consider tomorrow.

THE PRESIDENT: Can you put your motion, Mr. Larkin, to read something like this: That we accept the Committee's report as good information?

MR. A. E. LARKIN: That was my motion, Mr. President.

THE PRESIDENT: Well, word your motion.

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MR. A. E. LARKIN: It is simply that we thank the Committee very kindly for the work they have done, and for the information they have compiled; that we accept it as information to be handed on to the next year's Committee.

THE PRESIDENT: Well, Mr. Larkin does not care to withdraw his motion. Now, is there any further discussion on this motion before the house? Have you anything further to say? Is there anyone that has anything to say on it?

MR. J. C. WILLIAMS: Mr. President, when I was speaking on the Committee's original report I had in mind simply the quality of timber, the method of treatment, the penetration, and you might say the treating end of the report. I did not consider so much the foundation and the grading, and that part which pertains to construction matters with which I am not at all familiar, so that my original remarks should be qualified to the extent that they apply only to the timber and the treatment. I thought very well of his report, as far as those points were concerned, and I am not competent to pass on the foundation and the grading and the cushion, and so forth.

MR. H. S. LOUD: The report of the Committee on Wood Block Paving is gotten up by people who, being human and, therefore, liable to omit certain details, and possibly to give undue consideration to points which others would think were not very important. For instance, there is a slight difference of opinion in the Committee itself in regard to sand cushion and mortar cushion, and the question of a perfectly smooth concrete foundation. It is undoubtedly true there are a great many streets in excellent condition at the present time with sand cushion, but the Committee thought that there was so much opportunity for failure with a sand cushion where it was not laid properly, or where the drainage was not what it ought to be, that they would cut it out altogether.

Now, I do not know whether it is in the province of a committee putting in a report to an Association of this kind to deliberately cut out something which has given good satisfaction when properly done. There were some questions brought up, for instance, the idea of specifying an average of 80% of heartwood and allowing blocks with a minimum of heartwood. The reason for the 80% average was this, that all the specifications in this country are not identical, and that at times one purchaser will order blocks with 90% heartwood, and the manufacturer will naturally run through his stock of lumber and get out a whole lot of 90% heartwood to suit Mr. A., and then when Mr. B. comes along with a clause in his specification allowing 50% heartwood, he gets more sapwood than he ought to get for the good of the industry. While sapwood undoubtedly wears just about as well as heartwood, in my experience there is more of a tendency for sapwood

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to absorb water, to cause bulging and other trouble than there is in heartwood. Therefore, the Committee thought that it was well to restrict the average amount of sapwood in the whole street.

The question about penetration was discussed by the Committee, and we made a distinction between it and diffusion. It is possible to thoroughly penetrate a block, that is, drive the oil through from the outside to the center, and to put in 16 or 18 or even 20 lbs. of oil per cubic foot on the average, and you could say that it was thoroughly penetrated, the oil has gone all the way through. On the other hand, this would not mean that the preservative was thoroughly diffused through the block. For that reason we spoke about a satisfactory penetration. We might have said a thorough penetration and insisted that the sapwood should be thoroughly diffused throughout with the preservative.

The question of crown which Mr. Buehler brought up was not discussed to my knowledge at all. I think there is a rather important feature, and could be included either in this report, that the crown be made as small as possible, or a figure given; but it seems to me that the question of crown could be left to the succeeding Committee. This is a standing committee, and if we get a specification which is printed, and which has the tentative approval of this Association, it is possible to modify it from year to year and round it out into a complete specification as we get more information.

The question of street railway crossings which Mr. Fulweiler brought up is a question which is not only a very serious one in the city to which he refers, and which I immediately recognized as Philadelphia, but is due to the fact that they have very heavy cars, and the street railway company has not crossings with sufficient foundation. The crossings move up and down every time the cars go by, and they have shaken the blocks out. We arranged with the street railway company and city authorities there to put in granite instead of wood. We did that for two reasons. It showed them that the granite shook out just as well as the wood, and the only remedy, so far as I know in the case of the street railway track construction, is that you have got to have an absolutely firm, rigid construction to have the blocks give good satisfaction.

The question of steaming came up, and, as Mr. Cherrington said, was not a question of bleeding, but a means of getting good diffusion in the sapwood, and also of rendering the swelling of the block less liable; that is, to put back moisture in the wood which might have dried out too much during the seasoning period.

MR. A. E. LARKIN: It seems to me the very nature of Mr. Loud's remarks, and some of the remarks of the other members of

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the Committee, shows that they are not ready to say, "Here is a specification to be adopted." They admit that there have been a lot of essential things they have not had the time to take up at this time. I call for the question.

THE PRESIDENT: The question is called for. Now, you understand what the motion is, that we accept the report of the Committee, that we appreciate the work that they have done, and Mr. Larkin's motion is to refer it to the incoming Committee, so that they can round it out next year. There is one thought in the Chairman's mind, when are we going to get a specification? However, I do not vote on it. I will leave that to you. Only Corporate and Honorary members can vote. Those in favor of the motion say Aye; opposed No. The Chair is in doubt. Those in favor of the motion will stand on their feet, and the Secretary will count the votes.

THE SECRETARY: Twenty-six.

THE PRESIDENT: Those opposed to the motion stand on their feet.

THE SECRETARY: Five.

THE PRESIDENT: The motion is carried. We will pass to the next paper, Mr. Winslow's report, Committee No. 5, on Service Tests of Cross Ties.

MR. C. P. WINSLOW: I will have to ask you to allow us to postpone the presentation of this paper until tomorrow morning. There are points in it which the Committee still has under consideration.

THE PRESIDENT: Mr. Winslow, you have some blue prints you wanted to present to this Association on various kinds of woods. Have you got them?

MR. C. P. WINSLOW: I will be glad to present that if you have time for it.

THE PRESIDENT: How long will it take?

MR. C. P. WINSLOW: About ten or fifteen minutes.

THE CHAIRMAN: We have got an hour.

MR. C. P. WINSLOW: This is a discussion of the paper presented by Mr. Van Metre yesterday afternoon. You may recall that at that time my papers were not available. Before presenting my discussion I wish to make acknowledgment of the work of Mr. John Newlin, who has charge of the work relating to the mechanical properties of woods as conducted at our laboratory, and upon whose work and assistance much of the following is based:

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DISCUSSION ON WOODS SUITABLE FOR CROSS TIES.

By Carlile P. Winslow and John A. Newlin.

On page 2 of Mr. Van Metre's paper he refers to a method, suggested by the Forest Products Laboratory, for classifying the suitability of different species for cross ties by the development of a composite figure involving a number of mechanical properties. Since any method of classification is a matter of considerable importance to both the users and suppliers of ties, it seems well to present for your consideration some further explanation and analysis of the suggested method.

Table 1 covers in brief form the procedure followed in developing a composite figure for any species. While Table 2 gives the data inclusive, it lists the mechanical properties included, shows the relative weight assigned to each of them in the formation of the final figure, and points out the bearing of each to certain shocks, strains, etc., to which a tie is subjected. Briefly, the suggested method boils down to a combination of mechanical properties, as follows:

a.	Static and impact bending	28.5%
b.	Compression parallel to grain and end hardness	31.5%
c.	Compression perpendicular to grain and side hardness	40.0%
	Composite figure	100.0%

TABLE 1.—SHOWING BASIS OF DEVELOPMENT OF SUGGESTED COMPOSITE FIGURE.

Mechanical Property	Relative weight used in forming composite figures	Relation of mechanical property to use of species for cross ties
STATIC BENDING	Per Cent.	
a—Modulus of Rupture	14.3	These properties show the strength when used as a beam. They are of primary value in determining the resistance offered to breaking due to "center bindings."
b—Fiber Stress at Elastic Limit	7.1	
IMPACT BENDING		
a—Fiber Stress at Elastic Limit	7.1	
COMPRESSION PARALLEL TO GRAIN		These bring out the resistance offered to a compressive force exerted lengthwise along the grain, and are of value in indicating the resistance offered to lateral pressure on spikes.
a—Fiber Stress at Elastic Limit	7.2	
b—Maximum Crushing Strength	14.3	
END HARDNESS	10.0	Indicates the resistance to lateral pressure on spikes.
SIDE HARDNESS	20.0	Indicates the resistance to rail wear, abrasion, etc.
COMPRESSION PERPENDICULAR TO GRAIN		
a—Fiber Stress at Elastic Limit	20.0	

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Common Name / Species	Gravity Based on Volume when Green	Bending			Compression Parallel to Grain		Compression Perpendicular to Grain	Hardness		Nail Pull
		Fiber Stress at Elastic Limit	Modulus of Rupture	Fiber Stress at Elastic Limit	Fiber Stress at Elastic Limit	Maximum Crush Strength	Fiber Stress at Elastic Limit	Load required to imbed an 0.444" ball ½ its diam. End	Side	
	Lb. sq. in.	Lb. sq. in.	Lb. sq. in.	Lb. sq. in.	Lb. sq. in.	Lb. sq. in.	Lb. sq. in.	Lbs.	Lbs.	
Black Locust, Green	.660	8800	13800	18300	6280	6800	1430	1860	1850	...
Air-Dry	...	13820	20700	21580	7790	10880	2523	1572	1725	413
(Hickory)	.64	6065	11280	15694	3629	4574	1069	....	....	...
	...	11430	22060	24520	....	10520	2700	....	....	...
Sugar Maple	.56	5000	9100	12100	3120	3860	750	1000	880	...
	...	10440	15800	19110	6090	8570	1560	2000	1430	425
White Ash	.52	4900	9100	11700	3250	3800	800	1000	900	...
	...	10180	16800	16980	5620	8190	1540	1950	1320	408
White Oak	.60	4700	8300	10700	2990	3560	830	1120	1060	...
	...	8320	15250	17200	4350	7610	1336	1540	1370	323
(Birch, Sweet & Yellow)	.56	4570	8600	10970	2720	3490	480	890	790	...
	...	12650	19150	23000	7550	10060	1520	1760	1370	416
Red Oak	.56	3700	7700	10400	2330	3200	730	1020	950	...
	...	8620	14390	18510	4610	7370	1150	1500	1310	341
Beech	.54	4500	8200	10400	2550	3280	607	900	820	...
	...	8970	14950	19680	4870	7400	1340	1400	1190	430
Slippery Elm	.48	4000	8000	9100	2840	3310	510	750	660	...
	...	9400	14920	17750	5370	7800	1780	1220	900	...
Longleaf Pine	.55	5400	8700	10800	3840	4390	600	550	590	3
	...	.....	.....	.....	....	.....	....	....	....	302
Douglas Fir	.45	5000	7800	9400	3400	3940	530	510	470	...
Black Gum	.46	4000	7000	9800	2440	3040	600	790	640	...
	...	9250	10860	17120	4060	7000	1500	1380	854	...
Red Gum	.43	3460	6450	8930	2515	2690	390	642	578	...
	...	7180	10490	.....	....	5230	594	....	....	...
Shortleaf Pine	.49	4500	8000	11200	3650	3810	480	490	560	...
Loblolly Pine	.50	4400	7500	9500	2870	3580	550	400	450	...
Western Larch	.48	4600	7500	9400	3250	3800	560	470	450	...
Western Hemlock	.42	4400	7300	8000	2210	3390	334	535	420	...
	...	6330	10370	.....	....	5400	....	....	....	...

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Species Common Name	Specific Gravity Based on Volume when Green	Static Bending		Impact Bending	Compression Parallel to Grain		Compression perpendicular to Grain	Hardness		Nail Pull
		Fiber Stress at Elastic Limit	Modulus of Rupture	Fiber Stress at Elastic Limit	Fiber Stress at Elastic Limit	Strength Crush Maximum	Fiber Stress at Elastic Limit	Load required to imbed an 0.444" ball ½ its diam. End	Load required to imbed an 0.444" ball ½ its diam. Side	
	Lb. sq. in.	Lb. sq. in.	Lb. sq. in.	Lb. sq. in.	Lb. sq. in.	Lb. sq. in.	Lb. sq. in.	Lbs.	Lbs.	
Cotton Gum	.48	4300	7380	7650	2280	3550	451	814	700	...
	...	6310	8970	11030	3820	5850	865	1244	847	...
Cypress	.41	4000	6800	8000	3100	3490	470	470	380	...
Tamarack	.49	4200	7200	7800	3110	3480	4800	400	380	...
	...	8400	12050	12950	5150	7590	1080	720	640	...
Sycamore	.46	3300	6500	8800	2390	2920	450	700	610	...
	...	7570	11260	10780	4260	6280	1010	980	810	323
Silver Maple	.44	3100	5800	6800	1950	2490	460	670	590	...
	...	7680	10100	15000	5600	6600	1180	1380	750	302
White Elm	.44	5600	6900	8100	2290	2860	390	610	530	308
	...	9240	14640	16600	5270	6850	850	1240	880	...
Eastern Hemlock	.38	4200	6700	7900	2710	3270	500	510	410	193
					....	.....	....	....	....	193
Norway Pine	.44	3700	6400	7500	2470	3080	360	360	340	...
	...	9170	12300	15090	5660	7080	830	700	600	250
Red Spruce, Green	.38	3400	5700	7200	2360	2740	350	420	350	...
Air-dry	...	7370	10790	12120	5470	6380	620	670	1020	...
White Fir	.35	3900	6000	7200	2610	2800	440	380	330	...
					....	.....	....	....	....	170
Lodgepole Pine	.38	3000	5500	7200	2100	2610	310	320	330	...
Western Yellow Pine	.38	3100	5200	6700	2080	2460	320	310	320	...
					....	.....	....	....	....	190
White Spruce	.36	3300	5400	6800	2280	2380	270	300	280	...
Western Red Cedar	.31	3300	5100	7100	2500	2800	310	430	260	...
Basswood	.33	2700	5000	5200	1710	2210	210	280	250	...
	...	7290	10150	11220	4430	5980	580	590	450	177
Englemann Spruce	.31	2500	4200	5900	1740	1980	290	250	240	...
	...	4460	6800	8300	2980	3810	520	390	290	163
Alpine Fir	.31	2400	4400	5300	1660	2060	310	280	220	...

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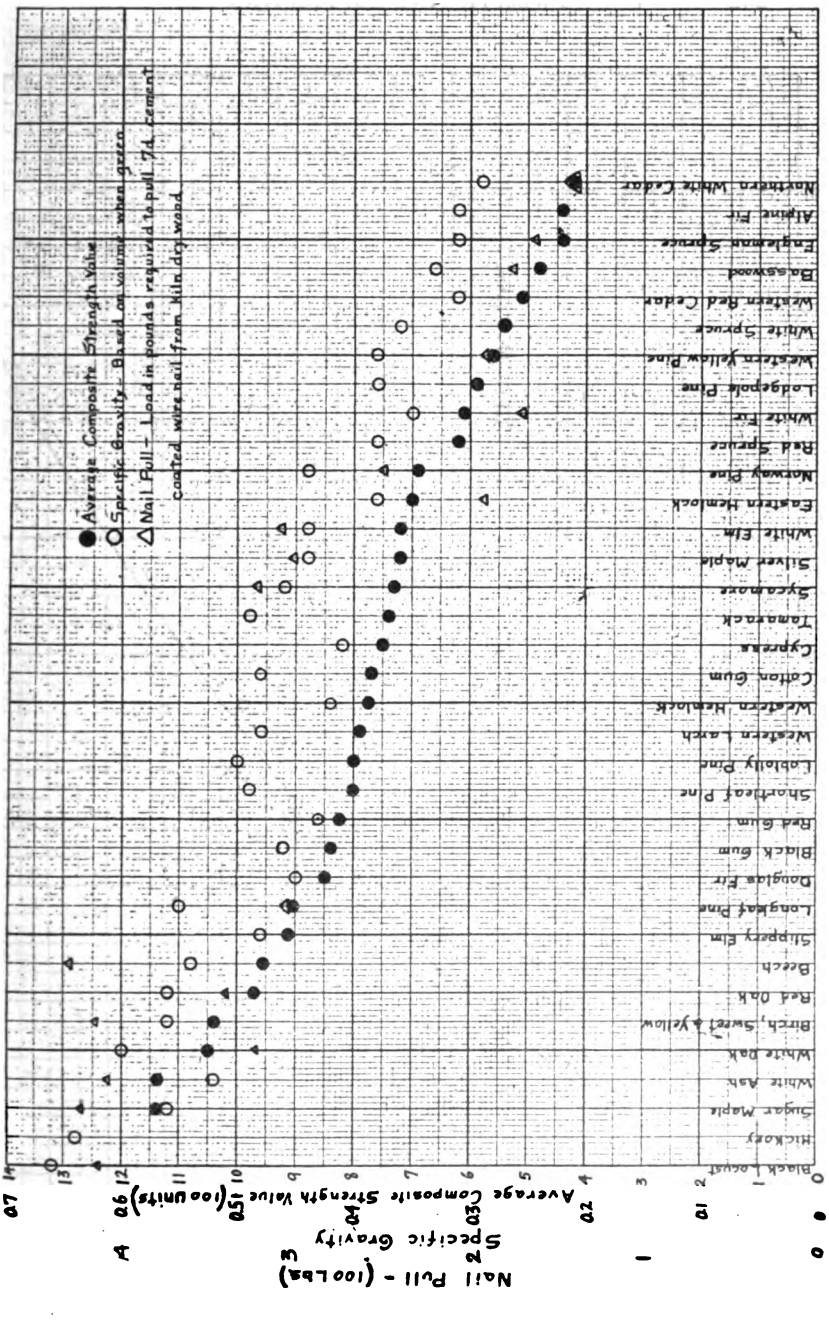
Average Composite Strength Value
Specific Gravity - Based on volume when green
Nail Pull - Load in pounds required to pull 7/8 cement coated wire nail from kiln dry wood
Nail Pull - (100 lbs)
Specific Gravity
Average Composite Strength Value (100 units)
Black Locust
Hickory
Sugar Maple
White Ash
White Oak
Birch, Sweet & Yellow
Red Oak
Beech
Slippery Elm
Longleaf Pine
Douglas Fir
Black Gum
Red Gum
Shortleaf Pine
Loblolly Pine
Western Larch
Western Hemlock
Cotton Gum
Cypress
Tamarack
Sycamore
Silver Maple
White Elm
Eastern Hemlock
Norway Pine
Red Spruce
White Fir
Lodgepole Pine
Western Yellow Pine
White Spruce
Western Red Cedar
Basswood
Engelmann Spruce
Alpine Fir
Northern White Cedar

FIG. 1.

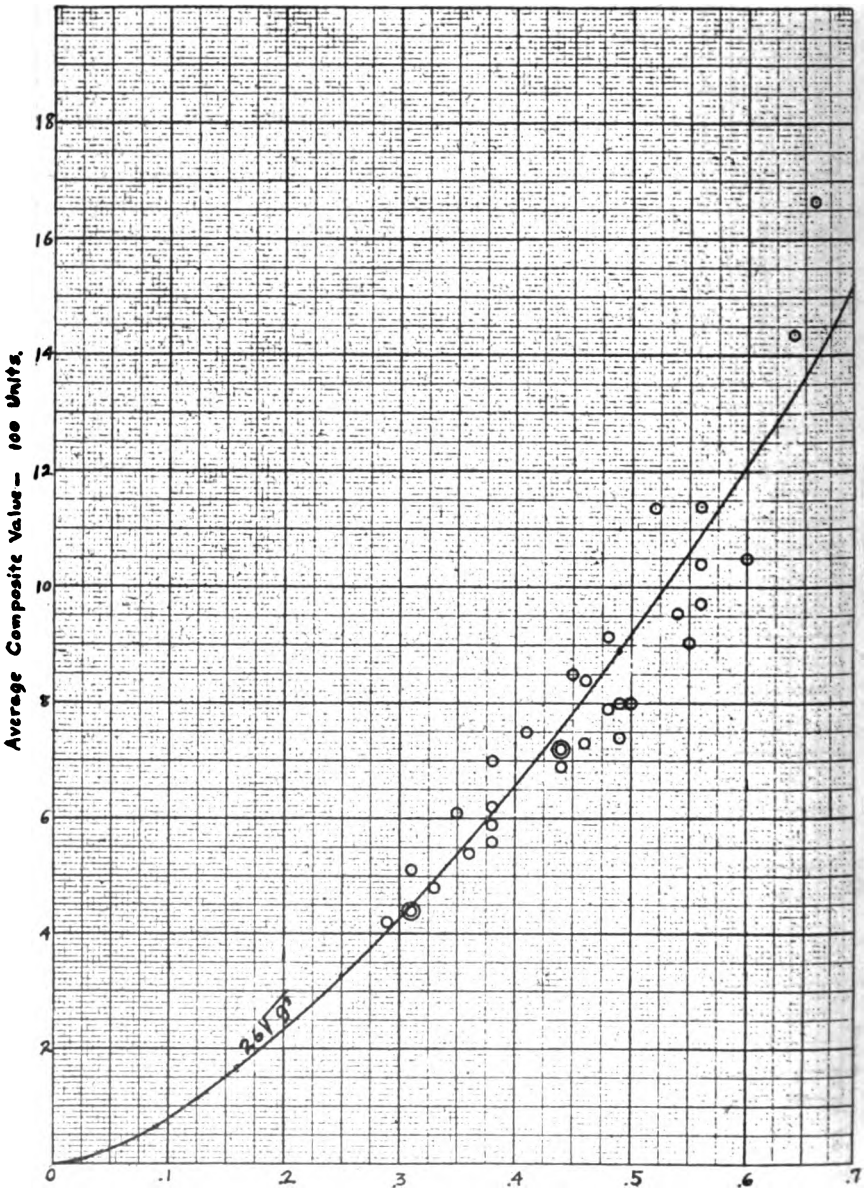

FIG. 2.

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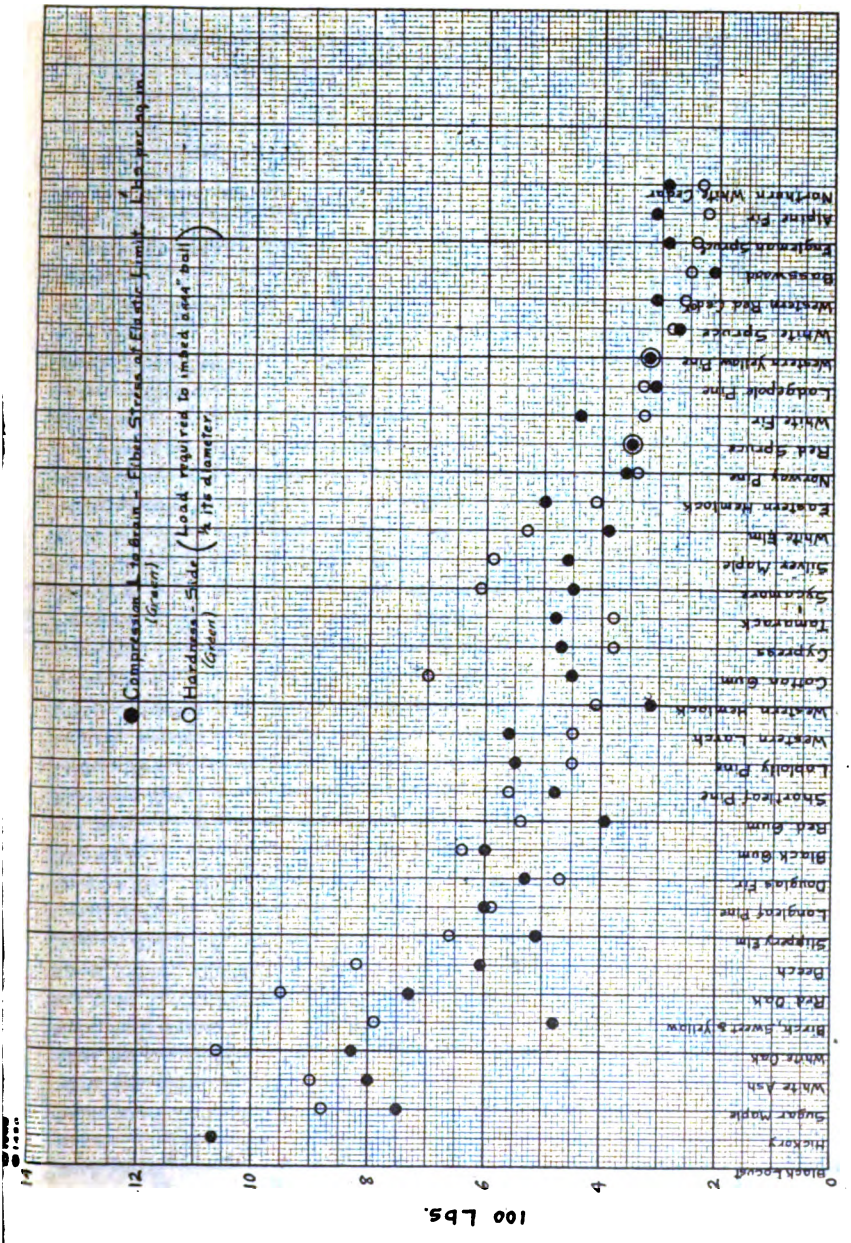

FIG. 3.

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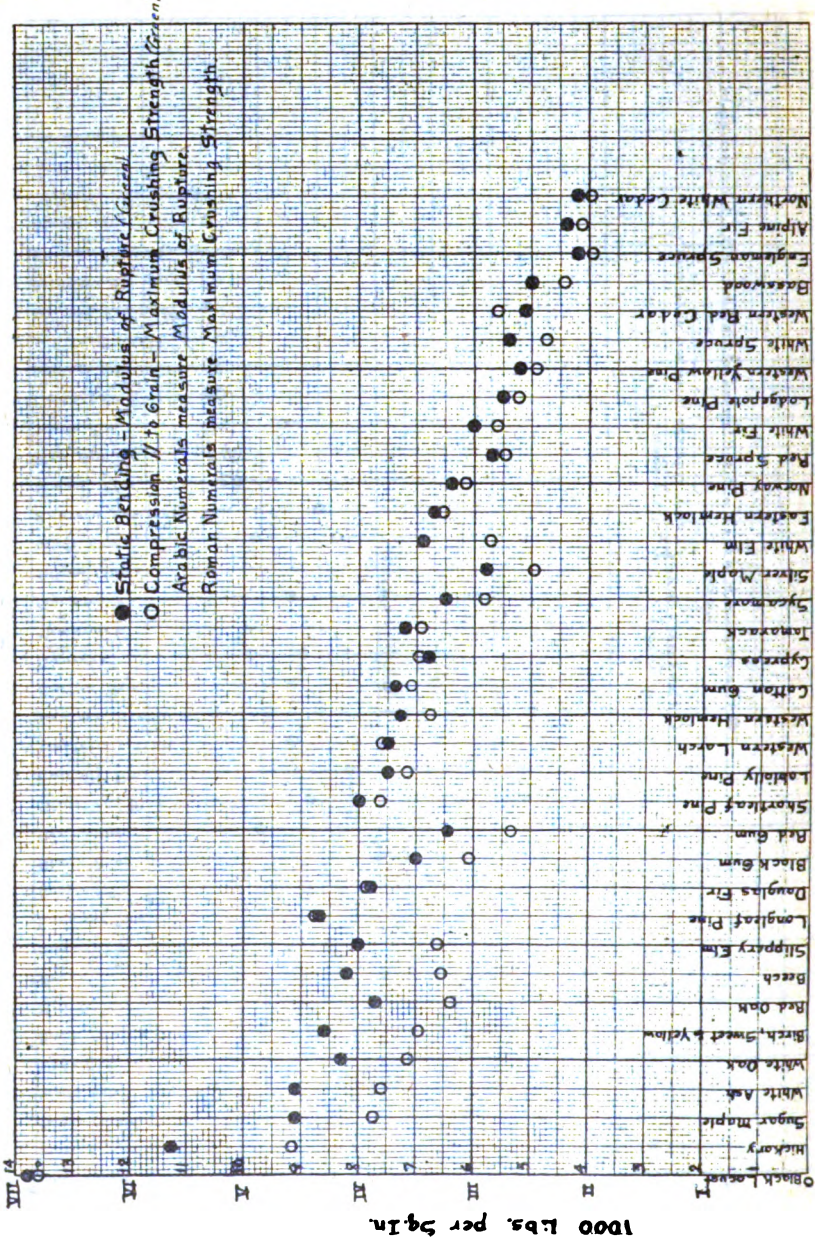

FIG. 4.

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Static and impact bending bring out the resistance offered to breaks due to "center binding," etc., compression parallel to grain and end hardness are indicative of the resistance which will be offered to lateral thrust on spikes, and compression perpendicular to grain and side hardness are a measure of the resistance offered to rail wear and abrasion.

Before attempting to discuss the merits or demerits of this method, let us consider a few important points which bear intimately upon the subject. To assist in this, Figures 1 to 4 and Table 2 have been prepared. In these the species are listed in order according to a composite figure developed as above described. The data, as presented in Table 2, are based on tests of small, clear specimens, both green and air-dry, selected for each species from five or more trees.*

(1) *Relation of Suggested Composite Figure to Specific Gravity.*

This is shown graphically in Figures 1 and 2. In the former the species are arranged in order as determined by the composite figure, which is represented in each case by a solid white circle. The open white circle indicates specific gravity. While there is more or less variation between the individual points, yet there is a striking similarity in the general tendency of the two series.

Fig. II makes a comparison on another basis, and further indicates how closely the suggested composite figure and the specific gravity fall together.

Further study of Figure 1 develops the fact that to list the species in the order of their specific gravity would require but slight modification of the order in which listed in Figure 1. The maximum change would be a movement of one species down the list six places, and it would be necessary to change only three species more than three places each.

(2) *Relation of Composite Figure to Resistance to Withdrawal of Nails.*

Fig. 1 also makes a comparison with the resistance to the withdrawal of nails. Were the species listed in this order instead of that of the composite figure, the maximum change would be an upward movement on the list of one species five places. With this exception it would be necessary to change no species more than two places on the list.

(3) *Resistance to Spike Pulling.*

It is recognized that an exhaustive comparison of species on this basis would probably be as interesting and valuable to users of ties as

*In the case of cotton, gum and western hemlock, specimens were secured from only four trees.

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any data which might be presented. Unfortunately, such data is not available, and we must rely largely upon an analysis and interpretation of certain established mechanical properties. The tests conducted some years ago by the Forest Service in regard to spike pulling were aimed at the determination of the effect of preservative treatment on the resistance to spike pulling, and, due to the variability of the conditions of test, the data do not provide a comparison of the different species. Other tests along the same line have been conducted by Mr. R. I. Weber, of the University of Illinois, and while this work did not exhaustively cover a comparison of species, yet from his series of tests he drew the following conclusion:

> Timbers having loose fiber structures have lower resistance to direct pull than the timbers having compact fiber structures.

It is assumed that this statement means substantially that the resistance to pull varies with the density or specific gravity, which is what might reasonably be expected.

(4) *Relation of Composite Figure to Other Mechanical Properties.*

Fig. III and IV further graphically compare the relation of the suggested composite figure to the following mechanical properties:

Fig. III. Compression perpendicular to grain—F. S. at E. L. Side hardness.

Fig. IV. Static Bending—M. of R. Comparison parallel to grain.

It is evident from these figures that each of these mechanical properties follows in general the same order as the composite figures for each species.

In attempting to use the suggested classification, it must be recognized that the mechanical properties of individual pieces of any species may vary as much as 30%, either above or below the average, this variation occurring according to whether the piece in question is dense, clear material, free from defects or decay, or vice versa. In addition, the effect of decay on the strength is of importance; material held for less than two years in storage, and giving evidence of decay only under the most careful inspection, was found under test to have less than 50% of the strength expected.

For these reasons great exactitude in the suggested composite figures is neither practicable nor advisable. The scale of species will serve to give a fair idea of the relation of one species to another, and from a practical standpoint it makes no great difference whether a species be listed either a few places higher or lower in the list.

Possibly a preferable method would be to separate the species into several groups, rather than to attempt to indicate a different composite value for each species. This plan, however, has the objection of mak-

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ing an extremely sharp distinction between species at the bottom of one group and the top of the group below.

THE PRESIDENT: This room is wanted at 6:30 for our banquet. We have two reports yet, No. 5 and No. 7, and then the Business Session. Now, if we meet promptly at 10 o'clock tomorrow morning the probability is that we can adjourn by one o'clock, not only adjourn, but close the convention. That will give the young men who have not seen Chicago by daylight a chance to see it. Some of them have seen it by moonlight. We will hear from our Committee on Entertainment.

MR. A. R. JOYCE: We have a banquet ticket for the man that has not bought. We have got a lot more out there, and can arrange for extra tables. Please be here at as near 6:30 as possible with the same clothes you have on now, unless you have an extra suit. You can change your clothes if you want to, but no evening dress, and we will start to eat between a quarter of seven and seven o'clock.

THE PRESIDENT: Gentlemen, I want to thank the convention for their prompt attendance at all the meetings. It really surprised me to see at 2 or 2.05 o'clock that this room was so full, although we did not adjourn till 1 o'clock—not quite full. Mr. Davidson is questioning what I say. That is all right, but there was a goodly number, and I want you to be here tomorrow morning promptly at 10 o'clock. We have got the report of the Committee on Constitution and By-Laws, and I do not know how much time that will take. That will depend on you. We are adjourned.

An adjournment was then taken till Thursday morning, January 20.

TWELFTH ANNUAL BANQUET.

THE TOASTMASTER, MR. A. R. JOYCE: Gentlemen of the American Wood-Preservers' Association: We have this evening as our guest of honor an engineer of national reputation, a man endowed not only with technical knowledge, but with that rare and unusual gift of common sense. I take great pleasure in introducing to you Professor F. H. Newell (applause).

PROF. F. H. NEWELL: Gentlemen, after that introduction I feel greatly embarrassed, for it is such a rare combination to have knowledge and common sense that I have learned to doubt their ability to mix (laughter). In sitting here I have been trying to get an inspiration from the beautiful portrait of our distinguished friend,

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Mr. Waterman (laughter). I cannot help but think of those eloquent words of George Ade, where he says that "a hair-lip is a man's misfortune, but whiskers are his own fault" (laughter).

If the operator will give us some pictures I will endeavor to describe them, and tell you something of the "wild and woolly West," of the country that many of you have seen. I know that all of you who have been there love to get back. I will try to tell you something about the forests and of the work being carried on by the Government in utilizing the forests, not merely for timber supply, but also for the value in preserving favorable conditions for water supply.

You as citizens own a part of this vast extent of plain and forest. You can go out and occupy the land and take up a farm if you wish of 160 acres. Uncle Sam will give it to you if you can live upon it. In other words, he bets you that you cannot stay there three or five years, and he generally wins (laughter).

I will not try to go into the details of forestry here in the presence of von Schrenk, Sterling, Foley and others of my friends in the old Forest Service. I could not tell much that is new about the work, and I know that you are so saturated in creosote and all the other preservatives that what you need is a little of the pure water and fresh air of Western scenery.

Out in that country are thousands and hundreds of thousands of acres of land, the sage-brush covered land stretching out far in the distance and apparently to the Eastern eye of no value, but in the vision of the engineer, the man of imagination, are pictures of a desert transformed and made into productive land capable of supporting a large population.

The engineer and the forester together are studying that country, with the idea of conserving the resources, not from use, but for use, of preserving the forests from destruction by fire, so that man may put them to the largest use. They are hunting for the valleys where water may be held in artificial lakes, and there with prophetic eye they see what can be done and what may be realized in the future.

Further down the streams the engineer explores the dry lands and dreams of the possibilities of saving this water and bringing it out on the thirsty deserts in the lower reaches, where the rivers disappear in the sand, and where from lack of water the cattle die after long wandering in search of a needed drink.

The desert country is not wholly unutilized. This vast extent of hundreds of thousands of acres is being grazed over in some places by the cattle, in others by sheep. The sheep man has been gradually driving out the "cow-puncher," and although the cow man has the greatest possible contempt for the sheep man, yet the latter, with his

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quiet ways and persistent effort, is pushing the sheep across the country, gradually eating out the cattle ranges, except where the Forest Service is preserving the grass and regulating the use of that great natural resource.

But by far the greater part of the land can be put to its best use only when the one missing element is supplied, namely, of water. The engineer must search unremittingly for possible sources of water and for reservoir sites, sometimes enduring hardships, and sometimes with pleasant experiences, as does the forester, who occasionally finds one of the beautiful upland parks, where he is able to get not only fuel for his fire, but water and grass for his animals. It is one of those pleasures of age to recall those early days when we were exploring the high mountains and going within places before unknown.

We can picture again one of the exploring parties hunting for a location for a road into the mountains to the site for a reservoir to hold the water which is needed for the dry land, or exploring to lay out the borders of the national forests which have been created, not only to preserve the timber for the use of the people, but, as I have said, for the beneficial effect on the supply of water for the thirsty lands below.

After many years of exploration, survey and study carried on in co-operation with Mr. Pinchot in the Forest Service, and with Foley, Sterling and others, the localities were finally selected where the work of building reservoirs might be undertaken. Various roads were built across the mountains to lead from the desert up to the sites of the great reservoir which we were constructing.

The result of these explorations, these surveys, this dreaming on the part of the engineer, lead up finally to the building of the great works here pictured. The largest of these is named after the man to whose efforts much of the success is due, and, therefore, we called it Roosevelt. The dam is a curved structure, built of what we call cyclopean concrete, a sort of pudding stone, in which the plums are pieces of rock of 10 or 12 tons in weight, bedded in soft concrete. The structure, as completed, is one of the finest of its kind, notable not only the biggest dam, but well worthy of the name of Roosevelt. The view which to me is particularly delightful, is one with the water pouring over the spill-ways, because during its building the floods imperiled the plant of the contractor; almost put him out of business a number of times; they seemed never to cease; but when the dam was built Nature had the joke on us, and stopped sending down water; it looked as though we had built a great dam where there was little water supply, but Nature relented just about the time the people were in despair. The floods again filled the reservoir with sufficient water to last for two years. (See illustration Fig. I).

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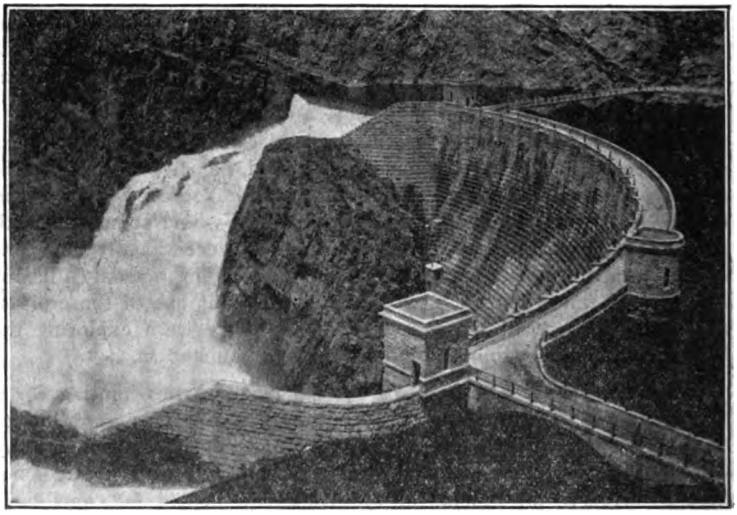

FIG. I

The Roosevelt Dam, Arizona, 70 miles northeast of Phoenix, Arizona. Height 280 feet, length, 1,125 feet, volume 342,000 cubic yards of rubble masonry. Creates a reservoir for floods from the National Forests holding 1,284,000 acre feet of water.

After the water is stored up in the mountain reservoirs it is allowed to flow down the canyons. In this case it continues down on the edge of the valley near the City of Phoenix, and is there turned out of the river by the Granite Reef dam, 1400 ft. in length, which diverts it into canals on both sides of the river. The divide and sub-divide, reaching every farm, 5,000 or more, there being an aggregate of many thousands of miles of waterways and many thousands of structures, bridges and other structures, to control the water. It comes out on the desert that before was absolutely worthless and uninhabitable. It has made possible the creation of homes which are relatively inexpensive, but surrounded by flowers and shrubs, in that country of daily sunlight they become beautiful, and yet without much care.

Farther down is the great Colorado River of the West. (See illustration Fig. II). The water of this river is flowing over a dam a mile in length, called the Laguna, reaching from the California across to the Arizona shore.

Because of the great depth to bed rock it was necessary to build the dam on soft sands. It is 150 ft. or more in width, and only 15 ft. high. It forces the water out into canals on each side in Arizona and California. These can be continued down into Mexico. The water of the river is extremely muddy, and if taken directly into the canals, they would soon be silted up, so the water is skimmed through small

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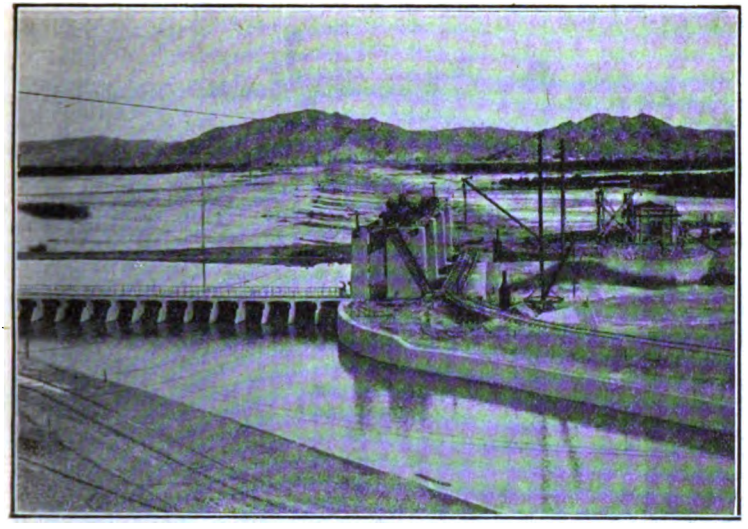

FIG. II

Laguna Dam, Arizona-California, on Colorado River, 20 miles above Yuma. Maximum height, 40 feet in main channel. Masonry, 66,714 cubic yards, rock fill, 375,018 cubic yards. Diverts water into canals in California and Arizona.

openings from a large forebay. When the forebay is nearly filled with mud it is flushed out.

When the water is taken by canals to the land along the Colorado in the vicinity of Yuma, the rich soil has a heavy growth of cottonwood and willows, which must be cleared at an approximate cost of $50 or more an acre. (See illustration Fig. III). When cleared and water brought to it the fields are capable of producing crops throughout the year, crop following crop in constant succession.

Another dream of the engineer which has come true is that of the Gunnison River, in Colorado.

The river is of considerable volume, but is in a narrow canyon, and the question was how to get it to the broad valley of the Uncompahgre, not far away. The engineers, after looking over the ground, said: "Let us bore a hole under the river horizontally and carry the water out." That has been done. The river has been turned through this hole or tunnel 6 miles long. The work was started under the bed of the river, mining towards the valley, and from the valley end in until the two tunnels met, forming a straight line six miles in length under the high plateau. It was a triumph of engineering skill that those tunnels, one over two miles in, and the other nearly four miles from the heading, met within a fraction of a foot. The water is now

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FIG. III

Land reclaimed by water diverted at Laguna Dam. Several crops produced each year; lettuce crop shown above.

coming from the Gunnison River, and is being applied to the valuable orchard lands and farm lands held at several hundred dollars an acre.

A wonderful transformation takes place when the little rivulets conducted to the apparently sterile lands wet the soil, rendering it fruitful and productive, and make possible the growth of the apples and other Western fruit familiar to you on the Chicago and Eastern markets. Other crops are produced, not only the ordinary field crops, but also some of the more valuable and intensely cultivated. But the great money crop of the country is alfalfa, which also serves to supply the needed nitrates.

Another engineering problem is of interest, that of the Boise River of southern Idaho, a clear watered, beautiful stream flowing out from steep mountains through lands which need waters to make them productive. There are no good reservoir sites on the stream. It heads far back where the mountains were high and covered with timber, and exploration failed to show a very desirable place to hold water. Choice was finally made of the place called the Arrow Rock, because the Indians in passing up and down the trail had a superstition that if a man could shoot an arrow and have it lodge in a particular crevice he would have peculiarly good luck. Those arrows sticking in the rock

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gave it the name "Arrow Rock." The first thing was to dig a tunnel through that projecting remnant of lava that projects into the stream, then build a cofferdam near the upper end of the tunnel and change the flow, shutting off the river and forcing it through the tunnel, and then putting in steam shovels and digging down a hole in the river bottom to bed-rock to form the foundation of the dam. (See illustration, Fig. IV.)

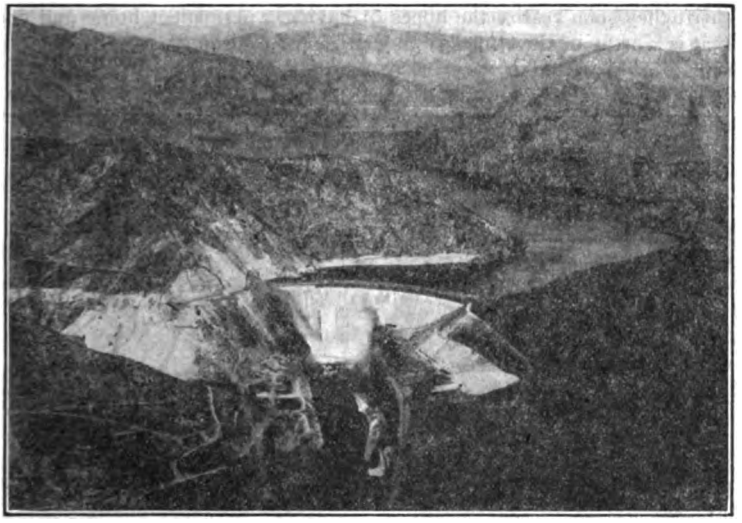

FIG IV

Arrowrock Dam, Idaho. Height 350 feet, the highest concrete dam in the world. Holds the flood waters of Boise River. Capacity, 230,000 acre feet.

Later the material thus excavated was put back in the form of concrete poured through spouts, day and night, week in and week out, month after month, the structure gradually rising, until it reached a height of 300 ft. above the bottom.

After the water is held behind this structure it is allowed to flow down the stream and is there diverted into a canal which is 40 to 70 ft. in width, in which it flows out onto the desert lands south of the city of Boise.

In central Wyoming, was found an excellent opportunity to build a dam in the granite canyon of North Platte River, blocking up the stream and creating a lake about 15 miles in length. This supplies water to lands in eastern Wyoming and western Nebraska, served by a canal on the north side of the North Platte River about 150 miles in length.

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Occasionally the water carried by gravity must be conducted across ravines in great flumes of steel or concrete or dropped down under the surface in an inverted syphon, hundreds of which must be planned and built to bring the water to the arid land. The latter are settled by people who are coming from all parts of the country. Some of them come on cars, some on foot, some drive with their outfits; the latter are the kind of men that make good settlers because they are accustomed to the roughing of western life. In a few years with patience and thrift they soon realize the hopes of having a permanent home and one that is worthy of the efforts of any citizen of the country. (See illustration, Fig. V.)

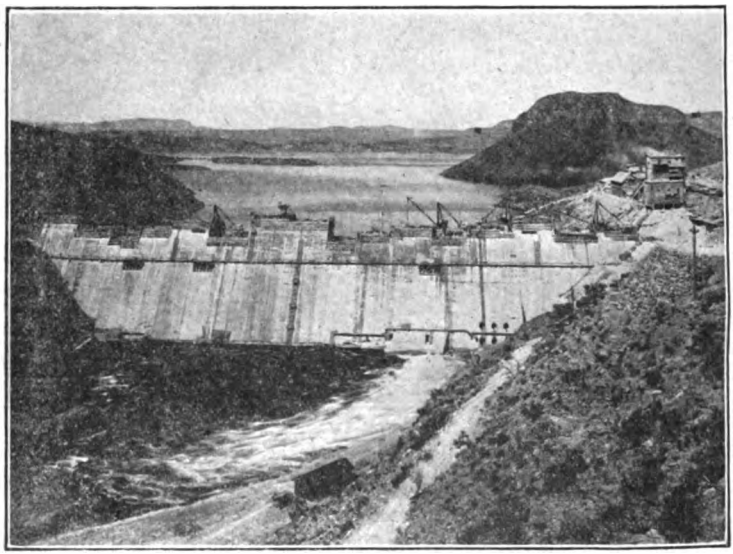

FIG V.

Elephant Butte Dam, N. M., on Rio Grande. Height, 270 feet, length, 1,200 feet, volume 500,000 cu. yards. Capacity of reservoir, 2,627,000 acre feet.

A different problem was that connected with the international troubles on the Rio Grande and the treaty with Mexico to rectify the boundary and to provide water for portions of Mexico as well as of Texas and New Mexico. A dam is being built at a point on the river known as Elephant Face because of that great massive basolt that projects through the sedimentary rocks and looks like a sleeping elephant. There the river has been turned into a concrete flume and the bottom excavated, the hole being later filled with concrete poured day after day, the work never stopping, but continuing month after month and year after year. Finally we have the great dam holding back the Rio Grande,

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providing storage for two years of its ordinary flow and utilizing its supply which otherwise would run to waste and interfere with the people down below.

While water is a good thing, too much is bad. The farmer pays for the water and thinks he must get his money's worth. Too much water injures the fields. The farmers do not believe this until they ruin a large proportion of their land, then in great straits they appeal for relief. Here was land that was originally a desert. Then by irrigation and by planting orchards the value increased to $300 or $400 an acre. They were destroyed by too much water and then the question came, what to do. The land covered with a thin coating of alkali or white salt could not support any useful vegetation. The only thing was to drain it. The land formerly dry was too wet to cross so it was necessary to put excavators in, supported on caterpillar tractors, working back through the artificial swamp. The excavated ditch is followed by the water bursting out from below and relieving the overcharged condition of the soil. By washing that alkalied soil, by putting in drain tile and keeping down the water table, at the same time enforcing a more economical use of the water, there is finally attained a permanent reclamation first produced by irrigation converting the desert into productive land and then into a swamp and then taking off the excess of water and restoring equilibrium so that the water table can be kept at the right height and the surface water applied when needed to produce the largest and best crops.

As has been said, the value of much of that work of reclamation depends upon the proper handling of the water and protection of the forests. All should be interested in the forests, not only as the source of timber, but for the beneficial effect in preventing excessive erosion and protecting the supply of water in the arid regions. We have a number of sawmills. We have cut a good deal of lumber. We have tried all the old style of conservation in handling the timber that we put into our bridges and flumes.

All of these things before described are resorted to in the effort, scientifically conducted, to utilize the natural resources to reclaim that land and make it productive of the foodstuffs needed for the people and which enable them to develop the local industries, to utilize the forests, to open the mines, especially the low-grade ores, to bring about a higher degree of civilization and to increase the amount of business which is done not merely in the West but in the Eastern cities. These western people living on the reclaimed lands are among the best buyers, furnish perhaps the best home market of any part of the United States.

A hundred millions of dollars have been expended by the Government in the work of reclamation, last year, although the work is not complete, the gross crop produced from the irrigated land was nearly

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$20,000,000. When the works are done the crop production will be many times that amount. The pioneers, of course, have had hard times in getting started. Every business at the outset to the man with small or no capital, requires for success, much devotion and even hardship. The reason many people fail is because they do not have the necessary knowledge or experience and they become discouraged. (See illustration, Fig. VI.)

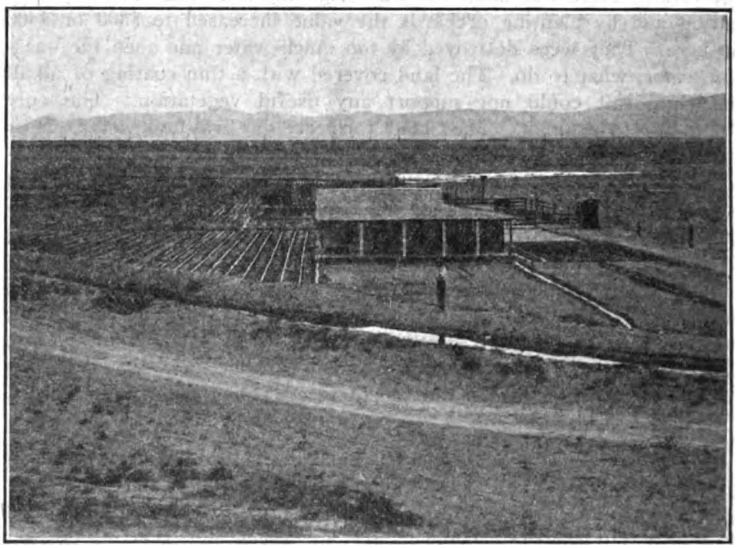

FIG. VI
The reclaimed desert, and the beginning of an American home.

This expenditure of $100,000,000 has been wisely invested and will produce returns for the country, larger than almost any other $100,000,000 that have been paid out. But the object of the undertaking is not the production of great engineering works, great monuments to skill or to the enlightened imagination, but to make possible the creation of homes and of opportunities to men of moderate means. If any of you present wish to lead a better life you come out and be a farmer. Uncle Sam will give you 40 acres and will bless you if you can make a living on it. He will be more than proud of you! The great thing is to give an opportunity to the landless men, to the man in the city or in the country who cannot otherwise obtain a home. Such men, located on the land, are needed for the backbone of our democratic institutions, men who can and will utilize opportunities offered.

I cannot do better in closing than to refer you to a saying attributed

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to Edward Everett Hale: "Whoever heard of a man shouldering his musket to fight for his boarding house?" Now, while we hope we will not be called upon to fight, yet we are more apt to fight effectively for a home like this than for a boarding house or flat in a city (applause).

THE TOASTMASTER: Gentlemen, we are doubly indebted for an interesting and profitable evening. Let us close by giving Mr. Newell a rising vote of thanks.

A rising vote of thanks and a hearty applause in appreciation of the interesting and profitable address by Prof. Newell closed the banquet program.

THURSDAY MORNING SESSION.

January 20.

The convention was called to order at 10 o'clock by President Waterman.

THE PRESIDENT: The first order of business will be the report of Standing Committee No. 5 on Service Tests by Carlile P. Winslow.

REPORT OF COMMITTEE ON SERVICE TESTS OF CROSS TIES.

To the Members of the American Wood-Preservers' Association:

The instructions issued to your Committee on Service Tests of Cross Ties at the time of its appointment were substantially as follows:

First: To compile and tabulate in a usuable form all the data which could be secured on service tests of ties in both steam and electric roads, indicating in each record the kind of wood and method of treatment and all other data which would be of value.

Second: To point out on what species of wood and character of treatments service records and data are especially lacking.

Third: To make recommendations as to how additional data might be effectively procured.

The Committee has so far as possible followed these instructions, and presents to you a report consisting briefly of the following:

1. A compilation of durability records of treated and untreated ties involving data on over 50 species and including over 1,200 individual records. This compilation has been under preparation by Messrs. Winslow and Teesdale of the Forest Products Laboratory at Madison, Wis., for some time, and it appears in this report as a contribution from its authors.

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2. A series of tabulations, summarizing the more important and apparently effective records presented in the above mentioned compilation.

3. Discussion of data included in the report.

4. Information on ties used in electric railways.

5. Recommendations.

It seems advisable to discuss the contents of the report in the order enumerated above.

Compilation of Records.

The authors of the compilation present with it a short description of the procedure followed in its preparation, the nature of its contents, and how it may be most effectively used for reference purposes. Further discussion of this phase of the report hardly seems necessary, except to point out that the compilation is believed to be the most complete which has yet been published, and will serve both as a valuable reference to practically all known durability records, and as a basis on which to build in the future.

Summary Tables.

While the detailed compilation discussed above is of prime value in forming a complete reference to all available records, it is recognized that it contains many records which are of little value in establishing the natural durability of the species, or in the effectiveness of treatment. This is due to the fact that, in some cases, individual records include results secured from several species, and from the available information it has been impossible to reclassify the data to show what was the result with each species separately; in other cases, the data regarding the method of treatment, absorption secured, character of track, conditions, etc., are insufficient to be of much value; while again in other cases, records may show a test started many years back, but apparently never followed up for a sufficient period to give valuable information.

For the foregoing reasons, a series of tabulations (Tables 1 to 7, inclusive) have been prepared to show in summarized form the results which have been secured from what may be termed the effective records which are available for untreated ties and ties treated by the processes in most general commercial use. These tables are classified, first by method of treatment, and secondly, by species, and serve as supplementary tabulations to the detailed compilations. Further information than is contained in the summary tables may be readily secured by reference to the detailed tables and from that point in many cases further data may be secured by correspondence with the individuals listed as authorities for the data.

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While all possible care has been taken in the preparation of these summary tables, it is recognized that errors of greater or less importance may have inadvertently occurred. The Committee will accordingly appreciate it if those noting such errors will kindly call them to its attention.

Discussion of Data.

Following is a brief summary of the information contained in the summarized tables:

SUMMARY.

(*Approximate.*)

Treatment	No. of Species	No. of Records			No. of Railroads		
		Completed	Unfinished	Total	Completed	Unfinished	Total
Untreated	42	115	172	287	15	21	27
Rueping	8	0	54	54	0	7	7
Lowry	3	1	5	6	1	1	2
Creosote (Full or Bethell)	27	15	147	162	9	29	31
Creosote (Open-Tank)	5	0	6	6	0	4	4
Zinc chloride	31	41	142	183	9	13	16
Card	21	0	91	91	0	3	3
Allardyce	18	9	25	34	3	4	4
Wellhouse	17	14	74	88	6	9	12
Total		195	716	911	27	47	54

It will be noted that the number of effective records is approximately 911, of which 716 are unfinished. Further information may be expected from these in the future. Furthermore, the total number of effective records is supplied by 55 railroads, of which 48 supplied the at present unfinished records.

Considering each table separately, the following points are noticeable.

Untreated Ties.—Of the total of 287 records, 200, or approximately 66%, are supplied by six railroads. Seventy-nine of the records are from the C. B. & Q.; 39 from the N. P.; 34 from the I. C.; 27 from the G. H. & S. A., and the remainder from the C. M. & St. P. and G. C. & S. F. Of the unfinished records, close to 50% are supplied by the C. B. & Q., which together with the I. C., N. P., and the C. M. & St. P., supply over 80%. Of the completed records, the longest life reported in the United States is 12 to 13 years for 1,185 juniper ties in the tracks of the Norfolk and Southern; the shortest record is approximately 2.5 years for 83 gum ties in the tracks of the G. H. & S. A.

Empty Cell Creosote Treatment.—This tabulation includes records on ties treated respectively by the Rueping and Lowry processes. It is of interest to note that of the total of 54 records of ties treated by the Rueping process none are yet completed. All of the records are

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covered by seven railroads, the I. C., and the A. T. & S. F. furnishing most of the records. The longest service so far reported is no removals of 146 pine ties after 9⅛ years in the Mexican Central Railway. The remaining records are on ties which have been in place from one to 11 years. The removals vary from nothing up to about 9%.

Of ties treated by the Lowry process, the total available effective records are six, located in the tracks of two railroads, (Big Four and D. L. & W.) One of the records, (the only one completed), shows an average life of 10 years for oak ties in the tracks of the Big Four Railroad with the added information that none were removed on account of rot. The remaining five records involve ties which have been in the tracks of the D. L. & W. for 1 to 5 years, with no removals reported so far.

Bethel and Full Cell Creosote Treatments.—Of a total of 162 records supplied by 31 railroads, 147 records from 29 railroads are unfinished. Of these, approximately 50% are supplied by the C. B. & Q. and 15% by the G. H. & S. A. Of the completed records, the best service reported in this country is an average life of 20 years for 400 hemlock ties laid in 1880 in the tracks of the N. Y., N. H., & H., with removals reported as due to rail-cutting and not to rot. The shortest service recorded is that of complete removal in 7 to 9 years of 20,000 yellow pine ties from the tracks of the D. L. & W., with the added information that many of them were killed by steaming during treatment, and removals largely caused by crushing under tie plates. With the unfinished records, some of the ties have been in service as long as 23 years, while others have been installed for only 1 or 2 years. They should ultimately give information of much interest.

Open-Tank Creosote Treatments.—But six records, none of which are completed, are available. The best service so far reported is no removals of 29 pine ties after 9½ years in the tracks of the Mexican Central Railway.

Straight Zinc Chloride Treatment.—There are 183 records involved in this treatment, of which 142 are at present uncompleted. Of these unfinished records, over 45% are on ties in the tracks of the C. B. & Q. Railroad, the remainder being scattered over 12 other roads. The maximum life so far reported shows approximately 10.7 years for 3,080 red oak ties in the tracks of the I. C. Railroad, and from 9 to 11.3 years for many thousands of Douglas fir ties in the tracks of the Southern Pacific. The minimum life reported is complete removal, at 3 years of 8 redwood ties in the tracks of the G. C. & S. F. and similar results at 5½ years with 1,000 sap pine ties in the tracks of the G. H. & S. A. and an average life of 5 to 6 years in the tracks of the Wabash.

Combination Zinc and Creosote Treatments.—These are considered in two divisions. First, those treated by the Card process, and

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secondly, those treated by the Allardyce and other methods of combination.

Of the Card treatment there are available a total of 91 records, all of which are still unfinished. These are all included in the tracks of three railroads, the C. B. & Q. furnishing 83 records and the C. M. & St. P., seven. Of the unfinished records, the best results reported show after 7 years no removals of 596 hard maple ties in the tracks of the C. M. & St. P.. while the poorest results reported show 67% removals on account of rail cutting of 160 loblolly pine ties after 6 years in the tracks of the C. B. & Q.

Of the Allardyce and other combination treatments, there are a total of 34 records, 25 of which are unfinished. These are included in four railroads,—the G. C. & S. F. and the G. H. & S. A. supplying by far the greater proportion. Of the completed records, the maximum life as reported is an average of 14 to 18 years for about 1,800 pine ties in the tracks of the G. H. & S. A. The minimum life is given as 100% removal of a few turkey oak ties after 3 years in the G. C. & S. F. Of the unfinished records, the best report is that of 41 Douglas fir, with only 5% removals in 8½ years in the tracks of the C. B. & Q.

It would appear from the foregoing that in order to round out and complete the data at present available, additional records are needed in the following:

1. Untreated ties of beech, birch, maple, gum, eastern and western hemlock, western larch and the various pines. These are species largely used for ties, and for which there are very little available durability data.

2. Untreated ties of Pinon pine, white fir, Alpine fir, red fir, (*Magnifica*) and Engleman spruce. These are species occurring in the West and Northwest, and offering the possibility of an increased use in the future.

3. Ties treated by the Lowry process and to somewhat less extent, by the Rueping process. Available records of these two processes are much fewer than with the other processes.

Information on Ties Used in Electric Railways.

Time has not permitted a thorough compilation of records on treated and untreated ties used in electric railways, but the following more or less general information may prove of interest.

1. *Untreated Ties: Interurban Lines.* The following estimates were secured from officials of six companies operating in the Middle West:

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TIES IN INTERURBAN LINES.

Cedar.	Untreated.	No tie plates.	7-8 years.		Michigan.
"	"		9-10 "		"
"	"	With " "	12-15 "		"
"	"		15-16 "		"
"	"	No " "	11-12 "		Illinois.
White oak	"	" " "	7- 8 "		Michigan.
			10-12 "		"
" "	"	" " "	6- 7 "		Indiana.

2. *Untreated Ties: Unpaved and Macadam Streets.* Officials of several companies operating in the Middle West supplied the following estimates:

Cedar.	Untreated.	11-12 Years.	Illinois.
White oak	"	8-10 "	"

Oak and beech. Reported as badly decayed and removed after 2 years from track laid on gravel ballast in Illinois.

3. *Untreated Ties: Paved Streets.* A third and important condition under which ties are used is in tracks in paved streets. The situation is complicated not only by lack of authentic data, but by the variety of types of construction in use. Some of those in use in the Middle West are:

(a) A monolythic construction of 6-in. concrete under and between the ties and about 1-in. over the top of the tie, followed by a 1 to 2-in. sand cushion upon which the brick is placed.

(b) Six inches of concrete foundation, then about a 1-in. sand cushion upon which the tie is placed, then concrete between and over tie to about 1 in., followed by sand cushion and brick.

(c) Six to 8 in. of rock or gravel ballast on which the tie is placed, then concrete between and slightly over the tie, followed by sand cushion and brick.

Some light is thrown on the service secured from untreated ties in these types of track by the following summation of opinions expressed by officials of a number of companies operating in the Middle West:

SUBSTANCE OF OPINIONS AS EXPRESSED BY OFFICERS OF VARIOUS COMPANIES.

Locality	Species	Life Un-Treated Years	Remarks
Michigan	White oak	12-15	Life of tie equal to life of rail.
"	" "	20	Life of tie equal to life of rail.
"	" "	10	.....
Illinois	" "	20-25	Equal to life of rail, provided tie is not disturbed.
Indiana	" "	20	Life of tie equal to life of rail.
Illinois	Hemlock	.....	.....
	Tamarack	15-20	Life of rail.
	Cedar	.....	.....

There was also rather a consensus of opinion among the operators of the Michigan properties that the tie would last as long as the rail, provided it was not removed from the track, but that, at least with cedar ties, decay had been observed to advance quite rapidly after removal from the track.

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In substantiation of the opinions expressed in Illinois, it was stated that untreated tamarack ties, which had been in place in a paved street for approximately 17 years, were examined when it became necessary to reconstruct the track and pavement. These ties were found in excellent condition, and were placed in the street when the new pavement was laid. This is the most striking case of long service in a paved street which has come to the attention of the writers.

Somewhat contradictory to the foregoing are the following data which were secured:

Michigan. Untreated ties in a paved street where repaving was under way were examined. These ties were reported as having been in service for 8 to 10 years. A number of cedar ties showed decay, especially on the ends, although the oak appeared in fair condition. Some of these ties had been removed from the street and placed in the storage yard, with a view to further use in open track. These ties were in bad condition, and most of them not fit for further use.

Figs. 1 and 2 illustrate the condition of two cedar ties, one of which had been removed from this street for approximately one month, and the other for approximately three months. It was reported that both of these ties looked perfectly sound when removed.

Michigan. Untreated red oak ties said to have been in a brick paved street laid on gravel for 8 years were examined as the entire reconstruction of the street was under way. They were practically all

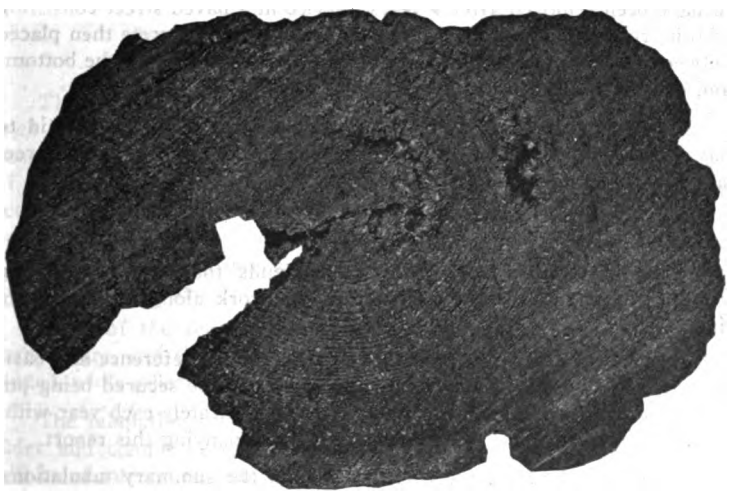

Fig. 1. Section of cedar tie removed from paved streets in Michigan. Tie reported to have been removed in October, 1913, after 8 to 10 years' service. Photo taken in November, 1913.

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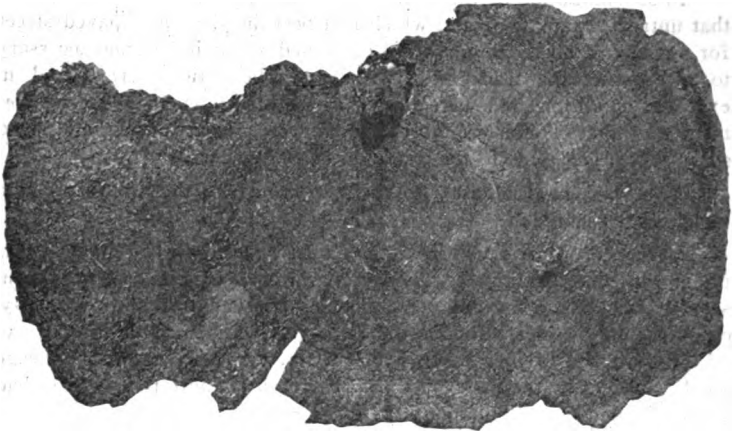

Fig. 2.—Section of cedar tie removed from paved streets in Michigan. Tie reported to have been removed in June, 1913, after 8 to 10 years' service. Photo taken in November, 1913.

in the most advanced stages of decay. The middle portions of the ties were in most cases entirely destroyed, leaving only small disconnected sections under the rails.

Illinois. Ties were examined in the storage yard, which were said to have been removed after 9 years' service in a paved street consisting of 6-in. rock ballast on which the tie was laid with concrete then placed between and over the ties and brick on top. Much decay on the bottoms and ends of the ties was noticed.

Other untreated ties seen in the storage yard, which were said to have been removed after 20 years' service from a brick paved street laid without concrete, showed bad decay.

Recommendations.

Your Committee respectfully recommends that, for the coming year, the attempt be made to continue the work along the following lines:

1. Use the detailed compilation of records as a reference and basis from which to proceed, additional data which can be secured being put in the form of this compilation and published separately each year without attempt to republish the compilations accompanying this report.

2. With completed records, as given in the summary tabulations, so far as possible secure additional information for those showing either exceptionally long or short service. This additional information to be included in subsequent reports of the Committee.

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3. With the uncompleted records, make every effort to keep them constantly up to date, presenting to the Association each year such tabulations together with such special reports as it may be practicable and advisable to include.

4. Continue the attempt to secure authentic information of the service secured from treated and untreated ties in the tracks of electric railways, both interurban and city lines.

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DURABILITY RECORDS OF CROSS TIES.

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The records embodied in the accompanying tables were compiled with a view to providing as complete and systematic a compilation as possible, to serve as a reference to all available records on the durability of treated and untreated cross ties. They comprise approximately 1,200 records on over 50 species, and include all records which it has been possible to locate by correspondence with railroads throughout the United States, and by intensive search of engineering literature extending over many years.

Some of the records have been available in published form for many years, and the experiments upon which they are based are concluded, while others are of comparatively recent origin.

The tabulation, therefore, is of value, both as a reference to the older and completed records, and to tests now under way, which it will be of interest to follow in the future.

In tabulating the data, the general procedure, so far as possible, was to include in each individual record ties of only one species, with the same method of treatment and average absorption, and subjected to approximately similar conditions in the track. For this reason, many

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TABLE 1. EFFECTIVE DURABILITY RECORDS.—UNTREATED TIES.

Species	Total Records		Completed Records				Unfinished Records			
	Rec.	R. R.	Number Rec.	Number Ties	Results	R. R.	Number Rec	Number Ties	Results	R. R.
Ash	4	1	.	.....	.....	.....	4	113	4 yrs—13 to 20% out 5 yrs.—76% out	C. B. & Q.
Beech	5	2	1	100	Avg. life 3 yrs.	G. C. & S. F.	4	206	4 yrs.—20% out 5 yrs.—71 to 87% out	"
Birch, Red	4	1	4	218	" " " "	C. B. & Q.	..	.....	.....	.....
Cedar	6	2	.	.....	.....	.....	1	83,200	10 yrs.—6% out	G. T.
	..	.	.	.....	.....	.....	1	500	13 yrs.—38% out	C. M. & St. P.
	..	.	.	.....	.....	.....	4	1,274	2-4 yrs.—none out	"
Chestnut	3	3	1	21,280	Avg. life 4.8 yrs.	I. C.	1	90	5 yrs.—9.3% out	C. B. & Q.
				2,816	" " 6.5 "	P. & R.	..	.....	.....	.....
Cottonwood	2	1	2	1	" " 4 "	C. B. & Q.	..	.....	.....	.....
Cypress	20	3	3	1,253	19 yrs.—100% out	G. H. & S. A.	9	14,958	5 yrs.—none out—10 yrs. 20-30% out—19 yrs. 50-100% out	G. H. & S. A.
	..	.	.	.....	.....	.....	4	228	4 yrs., 3-4% out, 5 yrs. 35 to 40% out	C. B. & Q.
	..	.	.	.....	.....	.....	4	1.096	3 to 4 yrs.—none out	I. C.
Cypress, yellow	7	1	1	25,600	7 yrs.—100% out	I. C.	6	195,679	7 to 10 yrs. 40 to 80% out	"
Cypress, red	1	1	.	.....	.....	.....	1	1,200	14 yrs.—4% out	"
Elm, white	5	1	1	30	Avg. life 5 yrs.	C. B. & Q.	4	192	4 yrs.—3 to 30% out 5 yrs.—70 to 75% out	C. B. & Q.
Fir, red	5	.	5	1,270,241	Avg. life 7 to 9 yrs.	Germany	..	.....	.....	.....
Fir, Douglas	27	4	8	772	8.3 yrs.—100% out	N. P.	16	2,012	8.3 yrs. 0 to 98% out	N. P.
	.	.	.	.....	.....	.....	1	89	8.5 yrs. 45% out	C. B. & Q.
	.	.	.	.....	.....	.....	1	64	4 yrs.—none out	W. V. & N.
	.	.	.	.....	.....	.....	1	137	4 yrs.—none out	C. M. & St. P.
Fir, Oregon	2	1	.	.....	.....	.....	2	2,013	4 yrs.—none out	O. W. Ry. & N. Co.
Gum, red	6	2	1	31	Avg. life 4 to 5 yrs.	C. B. & Q.	2	154	5 yrs. 80 to 90% out 6 yrs. 100% out	C. B. & Q.
Gum, Tupelo	5	2	3	42	" " 2.5 yrs.	G. H. & S. A.	2	135	5 yrs. 94 to 97% out	"
Gum, red	.	.	3	41	" " 2.5 "	"	..	.....	.....	.....
Hemlock	13	3	2	201	" " 2 to 3 yrs.	G. C. & S. F.	4	187	4 yrs. 7 to 15% out 5 yrs. 70 to 85% out	C. B. & Q.
	.	.	4	80	" " 6.5 yrs.	C. & N. W.	3	90	8.5 yrs.—70 to 95% out	C. & N. W.
Hemlock, western	2	1	2	203	" " 7.3 "	N. P.	..	.....	.....	.....
Hickory, pignut	4	1	..	.....	.....	.....	4	119	4 yrs.—0 to 44% out 5 yrs.—50 to 70% out	C. B. & Q.

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TABLE 1. EFFECTIVE DURABILITY RECORDS.—UNTREATED TIES.—CONTINUED.

Species	Total Records		Completed Records				Unfinished Records			
			Number		Results	R. R.	Number		Results	R. R.
	Rec.	R. R.	Rec.	Ties			Rec.	Ties		
Juniper	10	1	10	1,185	Avg. life 12 to 13 yrs.	N. & S.	..	.....	.....	.....
Larch, western	13	1	13	1,119	" " 6 to 8 yrs.	N. P.	..	.....	.....	.....
Maple	2	1	.	.....	.....	.....	2	100	3 yrs.—none out	C. M. & St. P.
Maple, hard	4	1	.	.....	.....	.....	4	120	4 yrs.—20 to 80% out 5 yrs.—86 to 96% out	C. B. & Q. "
Maple, soft	4	1	1	14	Avg. life 3 to 4 yrs.	C. B. & Q.	3	110	4-5 yrs.—76-97% out	"
Oaks, various	11	6	6	2,002,756	" " 10-16 yrs.	Germany	1	201,600	10 yrs.—47% out	B. & O.
	.	.	1	.....	" " 13.5 yrs.	France	1	8,605	7 yrs.—46% out	Erie
	.	.	.	.....	.....	.....	1	118,400	4 yrs.—25% out	Mo. P.
	.	.	.	.....	.....	.....	1	646,631	13 yrs.—75% out	M. & O.
Oak, Black	1	1	1	25	Avg. life 4.6 yrs.	G. C. & S. F.	..	.....	.....	.....
Oak, Chestnut	1	1	1	424	11 yrs.—99% out	B. & O.	..	.....	.....	.....
Oak, Danish	1	1	.	.....	.....	.....	1	3,500	11 yrs.—15% out	Denmark
Oak, Pin	4	1	.	.....	.....	.....	4	123	4 yrs.—none out 5 yrs.—46 to 52% out	C. B. & Q. "
Oak, Red	13	3	1	93	Avg. life 4 yrs.	G. C. & S. F.	5	257	4 yrs.—0-4% out 5 yrs.—70% out 6 yrs.—92% out	
	.	.	.	.....	.....	.....	4	160,000	5-7 yrs.—2-11% out	I. C.
	.	.	.	.....	.....	.....	3	200	3 yrs.—none out	C. M. & St. P.
Oak, Spanish	1	1	1	20	Avg. life 5 yrs.	G. C. & S. F.	..	.....	.....	.....
Oak, Swedish	1	1	.	.....	.....	.....	1	13,000	11 yrs.—62% out	Denmark
Oak, Turkey	1	1	1	20	Avg. life 4.3 yrs.	G. C. & S. F.	..	.....	.....	.....
Oak, White Mississippi	.	.	.	.....	.....	.....	1	274	4 yrs.—20% out	I. C.
Oak, White Tennessee	.	.	.	.....	.....	.....	1	274	4 yrs.—6% out	I. C.
Oak, White	35	12	1	8,400	Avg. life 3-5 yrs.	I. C.	4	125	4-5 yrs.—0 to 4% out	C. B. & Q.
	.	.	1	.....	" " 10 "	C. B. & Q.	6	3,743	3 to 4 yrs.—1-25% out	I. C.
	.	.	1	16,915	" " 8.6 "	P. & R.	5	157,176	3-7 yrs.—21-89% out	"
	.	.	1	300	" " 8.6 "	N. & S.	3	498,168	9-11 yrs. 13-40% out	"
	.	.	1	196	" " 6.75 "	G. C. & S. F.	4	1,012,300	3 yrs.—11% out, 7 yrs. 92% out	C. R. I. & P
	.	.	1	57,000	14 yrs.—100% out	L. S. & I.	1	342,400	5 yrs.—30% out	St. L. I. M. & S.
	.	.	.	.....	.....	.....	1	9,758	8 yrs.—32% out	M. R. & B.
	.	.	.	.....	.....	.....	1	500	18 yrs.—51% removed	C. M. & St. P.
	.	.	.	.....	Avg. life 22 R. Rds. 8.25 yrs.	.....	1	50	7.5 yrs.—36% out	C. & N. W.
	.	.	.	.....	.....	.....	1	760	4 yrs.—none out	B. & O.
	.	.	.	.....	.....	.....	2	355	4 yrs.—none out	C. M. & St. P.

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TABLE 1. EFFECTIVE DURABILITY RECORDS.—UNTREATED TIES.—CONTINUED.

Species	Total Records		Completed Records				Unfinished Records			
			Number		Results	R. R.	Number		Results	R. R.
	Rec.	R. R.	Rec.	Ties			Rec.	Ties		
Oak, Willow	1	1	1	20	4.5 yrs.—100% out	G. C. & S. F.	..	.....	.....	.....
Ohia,	2	1	.	.....	.....	.....	2	240	5 yrs.—none out	A. T. & S. F.
Pine	5	3	2	260,360	Avg. life 5 yrs.	Germany	..	.....	.....	.....
			1	.....	" " 7-8 yrs.	France	..	.....	.....	.....
			2	100	" " 2.57 yrs.	G. H. & S. A.	..	.....	.....	.....
Pine, Baltic	.	1	.	.....	.....	.....	..	1	9 yrs.—19% out	Denmark
Pine, Pacific	2	1	.	.....	.....	.....	2	22,500	11 yrs.—19% out 16 yrs.—67% out	"
Pine, Heart	7	1	7	2,649	Avg. life 5-9 yrs.	G. H. & S. A.	..	.....	.....	.....
Pine, Loblolly	6	2	1	100	2 yrs.—100% out	G. C. & S. F.	5	271	4 yrs.—25 to 44% out 5 yrs.—73 to 83% out 6 yrs.—95% out	C. B. & Q.
Pine, Lodgepole	2	2	.	.....	.....	.....	1	15	4 yrs.—none out	W. V. & N.
	..	.	.	.....	.....	.....	1	10	8.5 yrs.—40% out	C. B. & Q.
Pine, Longleaf	3	3	1	93	3 yrs.—91% out 9 yrs.—100% out	G. C. & S. F.	1	2,100	11 yrs.—none out 14-15 yrs. 87% out	C. M. & St. P.
	.	.	.	.....	.....	.....	1	99	4 yrs.—7% out	T. C. I. & R. Co.
Pine, Riga	.	.	.	.....	.....	.....	1	.....	7 yrs.—27% out	Denmark
Pine, Shortleaf	1	1	1	100	Avg. life 3.4 yrs.	G. C. & S. F.	..	.....	.....	.....
Pine, Swedish	9	1	9	353,300	" " 7-11 yrs.	Denmark	..	.....	.....	.....
Pine, White	1	1	1	.....	" " 5 yrs	C. B. & Q.	..	.....	.....	.....
Pine, Yellow	3	3	.	.....	.....	.....	1	7,500	10 yrs.—42% out	C. M. & St. P.
	.	.	.	.....	.....	.....	1	14,688	7 yrs.—12.3% out	N. Y. C. & H. R.
	.	.	.	.....	.....	.....	1	21,805	13 yrs.—43% out	P. & R.
Pine, Western Yellow	1	1	.	.....	.....	.....	1	15	4 yrs.—none out	W. V. & N.
Poplar	4	1	.	.....	.....	.....	4	129	4 yrs.—15-31% out 5 yrs.—65 to 70% out	C. B. & Q.
Sycamore	4	1	.	.....	.....	.....	4	140	4 yrs.—55 to 80% out 5 yrs.—95% out	"
Tamarack	11	5	1	7,500	Avg. life 7 to 8 yrs.	D. & I. M.	1	2,966	10 yrs.—35% out	G. N.
			4	132	" " 6 to 7 yrs.	C. & N. W.	4	172	4 yrs.—10-15% out 5 yrs.—80 to 83% out	C. B. & Q
			1	.....	3.5 yrs.—100% out	G. C. & S. F.	..	.....	.....	

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TABLE 2. EFFECTIVE DURABILITY RECORDS.—TIES TREATED BY EMPTY CELL CREOSOTE PROCESSES.

Species	Total Records		Completed Records				Unfinished Records			
			Number		Results	R. R.	Number		Results	R. R.
	Rec.	R. R.	Rec.	Ties			Rec.	Ties		
RUEPING										
Ash	2	1	.	.....	.....	.....	1	274	3 yrs.—none out	I. C.
	..	.	.	.....	.....	.....	1	274	4 yrs.—none out	"
Fir, Douglas	1	.	.	.....	.....	.....	1	40	8.5 yrs.—none out	C. B. & Q.
Gum, red	2	1	.	.....	.....	.....	2	114	8 yrs.—none out 9 yrs.—7.5% out	St. L. & S. F.
Gum	5	2	.	.....	.....	.....	1	203	4 yrs.—0.5% out	I. C.
	..	.	.	.....	.....	.....	4	15,500	5.7"—practically none out	A. T. & S. F.
Maple	2	1	.	.....	.....	.....	2	100	3 yrs.—none out	C. M. & St. P.
Oak, red	14	4	.	.....	.....	.....	2	197	6 yrs.— " "	St. L. & S. F.
			.	.....	.....	.....	4	445	8 yrs.— " "	"
			.	.....	.....	.....	2	548	3 yrs.— " "	I. C.
			.	.....	.....	.....	3	822	4 yrs.— " "	"
			.	.....	.....	.....	2	100	3 yrs.— " "	C. M. & St. P.
			.	.....	.....	.....	1	15	1 yr.— " "	C. B. & Q.
Pine	19	4	.	.....	.....	.....	1	.....	3 yrs.— " "	C. M. & St. P.
			.	.....	.....	.....	1	196	9.5 yrs.— " "	Mex. Cent.
			.	.....	.....	.....	4	195	7.5 yrs.— " "	G. H. & S. A.
			.	.....	.....	.....	1	2,176,417	2 yrs.— " "	A. T. & S. F.
			.	.....	.....	.....	12	90,630	10 yrs.—6 to 36% out; 11 yrs. 0 to 4% out	"
Pine, Loblolly	7	1	.	.....	.....	.....	2	822	3 yrs.—none out	I. C.
			.	.....	.....	.....	3	548	4 yrs.— " "	"
			.	.....	.....	.....	2	6,080	7 yrs.—1% out	"
Pine, Shortleaf	1	1	.	.....	.....	.....	1	49,000	7 yrs.—none out	C. M. & St. P.
Pine, Lodgepole	1	1	.	.....	.....	.....	1	25	8.5 yrs.— " "	C. B. & Q.
LOWRY										
Chestnut	1	1	.	.....	.....	.....	1	733	3 yrs.— " "	D. L. & W.
Oak	3	2	1	.....	Avg. life 10 yrs.	Big Four.	1	845	1 yr.— " "	"
			.	.....	.....	.....	1	6	3 yrs.— " "	"
Pine	2	1	.	.....	.....	.....	2	136	Placed 1915	"

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TABLE 3. EFFECTIVE DURABILITY RECORDS.—TIES TREATED WITH CREOSOTE BY FULL CELL AND BETHELL PROCESSES, ETC.

Species	Total Records		Completed Records				Unfinished Records			
			Number		Results	R. R.	Number		Results	R. R.
	Rec.	R. R.	Rec.	Ties			Rec.	Ties		
Ash	31	1	.....	.....	.....	.....	3	35	4-5 yrs.—none out	C. B. & Q.
Beech	8	4	1	356,650	Avg. life 25-30 yrs.	France	2	2000-6000	10 yrs.—0-63% out	Prussia
			.....	.....	.....	.....	1	21,440	20 yrs.—50% out	Germany
			.....	.....	.....	.....	4	468	4-5 yrs.—none out	C. B. & Q.
Birch, red	4	1	.....	.....	.....	.....	4	148	2-4 yrs.—none out	"
Chestnut	3	2	.....	.....	.....	.....	2	183	8 yrs.—none out	D. L. & W.
			.....	.....	.....	.....	1	32	1 yr.—none out	Picatinny Arsenal
Cottonwood	2	1	.....	.....	.....	.....	2	122	5 yrs.—none out	C. B. & Q.
Cypress	3	1	.....	.....	.....	.....	3	54	4 yrs.—none out	"
Elm, white	4	1	.....	.....	.....	.....	4	323	4-5 yrs.—2% broken	"
Fir, red	1	1	.....	.....	.....	.....	1	224	1 yr.—no report	Anaconda Mg. Co.
Fir, Douglas	7	3	.....	.....	.....	.....	5	442	8-3/10 yrs.—0-21.3% out	N. P.
			.....	.....	.....	.....	1	1,395,975	2 yrs.—none out	P. Ry. & Tr. Co.
			.....	.....	.....	.....	1	74	8.5 yrs.—1.4% out	C. B. & Q.
Fir, Oregon	1	1	.....	.....	.....	.....	1	1,000	5 yrs.—0.2% out	P. Ry. & Tr. Co.
Gum, red	8	2	.....	.....	.....	.....	2	133	5 yrs.—none out	C. B. & Q.
			.....	.....	.....	.....	6	200	9 yrs.8-43% out	C. H. & S. A.
Gum, Tupelo	8	2	.....	.....	.....	.....	2	151	5 yrs.—none out	C. B. & Q.
			.....	.....	.....	.....	6	201	9 yrs.—4-39% out	C. H. & S. A.
Hemlock	8	3	1	400	Avg. life 20 yrs.	NY,NH,&H	5	252	3-5 yrs.—none out	C. B. & Q.
			1	25,000	" " 5-12 yrs.	C. B. & Q.	1	5,000	10 yrs.—50-70% out	C. R. I. & P.

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TABLE 3. EFFECTIVE DURABILITY RECORDS.—TIES TREATED WITH CREOSOTE BY FULL CELL AND BETHELL PROCESSES, ETC.—CONTINUED.

Species	Total Records		Completed Records				Unfinished Records			
			Number				Number			
	Rec.	R. R.	Rec.	Ties	Results	R. R.	Rec	Ties	Results	R. R.
Hickory, pignut	3	1	.	.....	.....	.....	3	24	2 yrs.—none out	C. B. & Q.
Juniper	2	1	1	25	Avg. life 17 yrs.	N. & S.	1	75	15 yrs.—4% out	N. & S.
Maple	2	1	.	.....	.....	.....	2	100	3 yrs.—none out	C. M. & St. P.
Maple, hard	5	1	.	.....	.....	.....	5	128	3-5 yrs.—none out	C. B. & Q.
Maple, soft	4	1	.	.....	.....	.....	4	201	4-5 yrs.—none out	"
Oak	4	2	1	67,678	Avg. life 19.6 yrs.	Germany	.	.....	.....	.....
			3	1,402,050	" " 12-20 yrs.	France	.	.....	.....	.....
Oak, mixed	1	1	.	.....	.....	.....	1	3,850	In service 5 yrs.—last report	Pa. System
Oak, pin	5	1	.	.....	.....	.....	5	323	3-5 yrs.—none out	C. B. & Q.
Oak, post	1	1	.	.....	.....	.....	1	50	2 yrs.—none out	Q. & C.
Oak, red	17	9	.	.....	.....	.....	1	200	4 yrs.—none out	St. L. &S. W.
			.	.....	.....	.....	1	3,789	5 yrs.—none out	Pa. System
			.	.....	.....	.....	1	872	4 yrs.—none out	B. & O.
			.	.....	.....	.....	6	405	3-6 yrs.—0-1.8% out	C. B. & Q.
			.	.....	.....	.....	1	82	4 yrs.—9% out	T. C. & I. Co.
			.	.....	.....	.....	2	102	3 yrs.—none out	C. M. & St. P.
			.	.....	.....	.....	3	582	5 yrs.—none out	I. C. & S.
			.	.....	.....	.....	1	7	6 yrs.—none out	G. C. & S. F.
			.	.....	.....	.....	1	7	9 yrs.—none out	Mex. Cent.
Oak, water	1	1	.	.....	.....	.....	1	50	2 yrs.—none out	C. S.
Oak, white	4	2	.	.....	.....	.....	3	40	2 yrs.—none out	C. B. & Q.
			.	.....	.....	.....	1	200	4 yrs.—none out	St. L. & S. W.

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TABLE 3. EFFECTIVE DURABILITY RECORDS.—TIES TREATED WITH CREOSOTE BY FULL CELL AND BETHELL PROCESSES, ETC.—CONTINUED

Species	Total Records		Completed Records				Unfinished Records			
			Number		Results	R. R.	Number		Results	R. R.
	Rec.	R. R.	Rec.	Ties			Rec.	Ties		
Pine	18	7	1	6,000	Avg. life 16 yrs.	NYNH&H	1	16,000	1 yr.—none out	Fla. E. Coast
			1	150,000	Avg. life 19 yrs.	H. & T. C.	3	57	9.5 yrs.—none out	Mex. Cent.
			1	15,000	18 yrs.—45-55% out Records lost	L. & N.	1	1,893	16 yrs.—72% out	L. & N.
			.	.....	.....	.....	9	5,401	3-8 yrs.—0-2% out	G. H. & S. A.
			.	.....	.....	.....	1	183	4 yrs.—17% out	T. C. I. & R. R. Co.
Pine, Loblolly	9	5	.	.....	.....	.....	1	1,000	6 yrs.—none out	Ga. Rrd.
			.	.....	.....	.....	1	50	2 yrs.—none out	Q. & C.
			.	.....	.....	.....	4	209	4-5 yrs.—none out	C. B. & Q.
			.	.....	.....	.....	1	2,743	2 yrs.—none out	Pa. Sys.
			.	.....	.....	.....	2	599	4 yrs.—none out	St. L. & S. W.
Pine, Lodgepole	1	1	.	.....	.....	.....	1	39	8.5 yrs.—none out	C. B. & Q.
Pine, Longleaf	3	2	.	.....	.....	.....	1	250	23 yrs.—40% out	A. C. L.
			.	.....	.....	.....	2	600	4 yrs.—none out	St. L. & S. W.
Pine, Shortleaf	5	4	1	5,000	Avg. life 15.5 yrs.	C.R.P&N.S.	1	2,494	5 yrs.—none out	Pa. Sys.
			.	.....	.....	.....	2	563	4 yrs.—none out	St. L. & S. W.
			.	.....	.....	.....	1	150,000	2 yrs.—none out	H. & T. C.
Pine, Virginia	2	2	.	.....	.....	.....	1	10,000	8 yrs.—none out	C. R. R. of N. J.
			.	.....	.....	.....	1	10,000	4 yrs.—none out	P. & R.
Pine, Yellow	2	1	2	20,000	7-9 yrs.—all out	D. L. & W.	.	.....	.....	.....
Pine, Southern Yellow	2	1	1	6,000	Avg. life 16.4 yrs.	NYNH&H	1	500	9 yrs.—no results	NY,NH&H.
Poplar	3	1	.	.....	.....	.....	3	80	2 yrs.—none out	C. B. & Q.
Sycamore	3	1	.	.....	.....	.....	3	90	2 yrs.—none out	"
Tamarack	5	1	.	.....	.....	.....	5	225	3-5 yrs.—none out	"

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TABLE 4. EFFECTIVE DURABILITY RECORDS.—TIES TREATED BY THE OPEN-TANK CREOSOTE PROCESS.

Species	Total Records		Completed Records				Uncompleted Records			
			Number				Number			
	Rec.	R. R.	Rec.	Ties	Results	R. R.	Rec.	Ties	Results	R. R.
Fir, Douglas	1	1	.	..	.....	.....	1	32	8.5 yrs.—no results given	C. B. & Q.
Hemlock	1	1	.	..	.....	.....	1	33	8.5 yrs.—none removed 66%—good, 33%—partly decayed	C. & N. W.
Tamarack	1	1	.	..	.....	.....	1	19	7.5 yrs.—none removed	C. & N. W.
Oak, red	2	2	.	..	.....	.....	2	14	6 yrs.—none removed 9 yrs.—none removed	G. C. & S. F. Mex. Cent.
Pine	1	1	.	..	.....	.....	1	29	9.5 yrs.—none removed	Mex. Cent

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TABLE 5. EFFECTIVE DURABILITY RECORDS—TIES TREATED WITH STRAIGHT ZINC CHLORIDE.

Species	Total Records		Completed Records				Unfinished Records			
	Rec.	R. R.	Number Rec.	Number Ties	Results	R. R.	Number Rec.	Number Ties	Results	R. R.
Ash	2	1	.	.....	.....	.....	2	31	4 yrs.—none out	C. B. & Q.
Beech	6	3	.	.....	.....	.....	4	314	4 yrs.—none out 5 yrs.—1-3% out	"
			.	.....	.....	.....	1	99	10 yrs.—76% out	G. C. & S. F.
			.	.....	.....	.....	1	500	4 yrs.—0.2% out	C. M. & St. P.
Birch, Red	3	1	.	.....	.....	.....	3	103	4 yrs.—none out	C. B. & Q.
Chestnut	1	1	.	.....	.....	.....	1	21	3 yrs.—none out	C. M. & St. P.
Cypress	3	1	.	.....	.....	.....	3	55	4 yrs.—none out	C. B. & Q.
Elm, White	4	1	.	.....	.....	.....	4	296	4 yrs.—none out 5 yrs.—2.6% out	"
Fir, Douglas	23	3	8	161,719	Avg. life 9-11.3 yrs.	S. P.	6	267,420	6-11 yrs.—23-80% out	S. P.
			.	.....	.....	.....	6	749,908	0-15 yrs.—0-7.4% out	"
			.	.....	.....	.....	2	197	8.3 yrs.—1-4% out	"
			.	.....	.....	.....	1	91	8.5 yrs.—3.2% out	C. B. & Q.
Fir, Oregon	1	1	.	.....	.....	.....	1	5,414	5 yrs.—54% out	"
Gum, Red	9	2	.	.....	.....	.....	3	130	3 yrs.—none out 5 yrs.—7% out	"
			.	.....	.....	.....	6	244	9 yrs.—80-97% out	G. H. & S. A.
Gum, Tupelo	8	2	6	198	Avg. life 7-8 yrs.	G. H. & S. A.	2	117	5 yrs.—1.3% out	C. B. & Q.
Hackberry	1	1	.	.....	.....	.....	1	60	16 yrs.—75% out	"
Hemlock	16	5	.	.....	.....	.....	4	214	5 yrs.—0-1.4% out	"
			.	.....	.....	.....	7	19,626	6-9 yrs.—0-30% out	Pa. Sys.
			.	.....	.....	.....	1	100	10 yrs.—30% out	G. C. & S. F.
			.	.....	.....	.....	1	25	7.5 yrs.—16% out	C. & N. W.
			.	.....	.....	.....	1	2,000	15 yrs.—25% out	C. R. I. & P.

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TABLE 5. EFFECTIVE DURABILITY RECORDS.—TIES TREATED WITH STRAIGHT ZINC CHLORIDE.—CONTINUED.

Species	Total Records		Completed Records				Unfinished Records			
			Number		Results	R. R.	Number		Results	R. R.
	Rec.	R. R.	Rec.	Ties						
Hickory, pignut	3	1					3	24	2 yrs.—none out	C. B. & Q.
Larch, Western	2	1					2	193	7.3 yrs.—5% out	N. P.
Maple, hard	3	1					3	65	2 yrs.—none out	C. B. & Q.
Maple, soft	4	1					4	181	4 yrs.—none out 5 yrs.—3% out	"
Oak, black	1	1	1	34	Avg. life 8 yrs.	G. C. & S. F.				
Oak, pin	3	1					3	69	2 yrs.—none out	C. B. & Q.
Oak, red	38	8	2		Avg. life 8.5-12 yrs.	I. C.	5	292	4 yrs.—none out 5 yrs.—3% out	"
			1	3,080	Avg. life 10.7 yrs.	"	2	1,100	10 yrs.—none out 14 yrs.—13% out	"
			1	25	10 yrs.—100% out	N. & S.	1	35,120	8 yrs.—5% out	"
			1		Avg. life 5-6 yrs.	Wabash.	4	68,330	3-4 yrs.—1% out	I. C.
		1	1	255,574	Estimated life 10 yrs.	G. T.	9	591,526	5-6 yrs.—0-4% out	"
			1	20	7.5 yrs.—100% out	G. C. & S. F.	1	135	8 yrs.—26% out	Pa. Sys.
							5	538	3-4 yrs.—none out	C. M. & St. P.
							2	7,384	6 yrs.—0.13% out 7 yrs.—3% out	"
							2	88	10 yrs.—30% out	G. C. & S. F.
Oak, Turkey	1	1	1	20	7.5 yrs.—100% out	G. C. & S. F.				
Oak, white	5	1	1	100	Avg. life 4.18 yrs.	"	1	101	10 yrs.—64% out	G. C. & S. F.
							3	40	2 yrs.—none out	C. B. & Q.
Oak, willow	1	1	1	20	7.5 yrs.—100% out	G. C. & S. F.				
Pine	9	3	3	225	Avg. life 15-16 yrs.	N. & S.	1	43	9.5 yrs.—none out	Mex. Cent.
							1	300	13 yrs.—none out	N. Y. N. H. & H.
							4	17,355	10-11 yrs.—35% removed	A. T. & S. F.

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TABLE 5. EFFECTIVE DURABILITY RECORDS.—TIES TREATED WITH STRAIGHT ZINC CHLORIDE.—CONTINUED.

Species	Total Records		Completed Records				Unfinished Records			
			Number		Results	R. R.	Number		Results	R. R.
	Rec.	R. R.	Rec.	Ties			Rec.	Ties		
Pine, Black Hills	1	1	.	.....	.....	.....	1	6,359	14 yrs.—6% out	C. B. & Q.
Pine, Loblolly	6	2	1	100	9 yrs.—100% out	G. C. & S. F.	5	1,370	3-4 yrs.—0.5% out	I. C.
							4	293	4 yrs.—none out 5 yrs.—3-4% out	C. B. & Q.
Pine, Lodgepole	3	1	1	61	Avg. life 8.7 yrrs.	C. B. & Q.	2	2,059	8 yrs.—4% out	C. B. & Q.
Pine, Longleaf	3	2	2	71	13 yrs.—100% out	NY,NH,&H.	1	6	10 yrs.—17% out	G. C. & S. F.
	2	..	.	.....	.....	.....	2	135	13 yrsr.—10% out	NY,NH.&H.
Pine, Mountain	3	2	.	.....	.....	.....	1	10	10 yrs.—20% out	G. C. & S. F.
			.	.....	.....	.....	1	305	11 yrs.—7% out	A. T. & S. F.
Pine, sap	4	2	3	1,001	Avg. life 5.5 yrs.	G. H. & S. A.	..	.....	.....	.....
Pine, Shortleaf	..	..	6	92,206	Avg. life 6-8 yrs.	S. P.	3	107	10 yrs.—60% out	G. C. & S. F.
	11	3	.	.....	.....	.....	2	1,000	8-12 yrs.—10% out	C. M. & St. P.
Poplar	3	1	.	.....	.....	.....	3	80	2 yrs.—none out 4 yrs—5-10% out	C. B. & Q.
Redwood, California	.	..	1	8	3 yrs.—100% out	G. C. & S. F.	..	.....	.....	.....
Sycamore	.	..	.	.....	.....	.....	3	90	2 yrs.—none out	C. B. & Q.
Tamarack	.	..	.	.....	.....	.....	4	212	4 yrs.—none out 5 yrs.—1% out	C. B. & Q.
			.	.....	.....	.....	1	49	9 yrs.—none out	G. C. & S. F.
			.	.....	.....	.....	1	2,580	11 yrs.—2.2% out	G. N.
			.	.....	.....	.....	4	388	7.5 yrs.—none out	C. & N. W.

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TABLE 6. EFFECTIVE DURABILITY RECORDS.—TIES TREATED WITH COMBINATION OF CREOSOTE AND ZINC CHLORIDE.

Species	Total Records		Completed Records				Unfinished Records			
			Number				Number			
	Rec.	R. R.	Rec.	Ties	Results	R R.	Rec.	Ties	Results	R. R.
CARD PROCESS										
Ash	4	1	.	..	.....	.....	4	374	4-5 yrs.—none out	C. B. & Q.
Beech	6	2	.	..	.....	.....	5	1257	3-4 yrs.—none out 5 yrs.—0.4% out	"
							1	344	3 yrs.—none out	C. M. & St. P.
Birch, Red	4	1	.	..	.....	.....	4	1069	4 yrs.—none out 5 yrs.—1% out	C. B. & Q.
Chestnut	2	1	.	..	.....	.....	2	254	5 yrs.—19% out	"
Cottonwood	2	1	.	..	.....	.....	2	446	5 yrs.—1 to 11% out	"
Cypress	4	1	.	..	.....	.....	4	673	4-5 yrs.—none out	"
Elm, White	6	1	.	..	.....	.....	6	1381	4 yrs.—none out 5-6 yrs.—0-3% out	" "
Gum, red	3	1	.	..	.....	.....	3	840	5-6 yrs.—1% out	"
Gum, Tupelo	2	1	.	..	.....	.....	2	672	5 yrs.—1% out	"
Hackberry	1	1	.	..	.....	.....	1	45	3 yrs.—none out	"
Hemlock	5	2	.	..	.....	.....	1	1000	5 yrs.— "	C. M. & St. P.
							4	1296	4-5 yrs.— "	C. B. & Q.
Hickory, pignut	4	1	.	..	.....	.....	4	289	4 yrs.—none out 5 yrs.—1% out	"

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TABLE 6. EFFECTIVE DURABILITY RECORDS.—TIES TREATED WITH COMBINATION OF CREOSOTE AND ZINC CHLORIDE.—CONTINUED.

Species	Total Records		Completed Records				Unfinished Records			
			Number				Number			
	Rec.	R. R.	Rec.	Ties	Results	R. R.	Rec.	Ties	Results	R. R.
Maple	3	1					2	100	3 yrs.—none out	C. M. & St. P.
							1	596	6 yrs.—none out	"
Maple, Hard	6	2					5	1373	3-4 yrs.—none out 5 yrs.—0.5% out	C. B. & Q.
							1	596	7 yrs.—none out	C. M. & St. P.
Maple, Soft	4	1					4	721	4-5 yrs.—none out	C. B. & Q.
Oak, Pin	4	1					4	832	4-5 yrs.—none out	"
Oak, Red	7	2					6	1480	3-4 yrs.—none out 5-6 yrs.—1% out	"
							1	1237	4 yrs.—none out	B. & O.
Oak, White	5	1					5	765	4 yrs.—none out 5-6 yrs.—0 to 3% out	C. B. & Q.
Pine, Loblolly	5	1					5	1446	4-5 yrs.—0 to 8% out 6 yrs.—67% removed for rail-cutting	"
Poplar	4	1					4	624	4 yrs.—none out 5 yrs.—3-10% out	"
Sycamore	4	1					4	518	4 yrs.—none out 5 yrs.—1-3% out	"
Tamarack	6	2					5	1345	3-5 yrs.—none out	"
							1	8	1 yr.—none out	C. M. & St. P.

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TABLE 6. EFFECTIVE DURABILITY RECORDS.—TIES TREATED WITH COMBINATION OF CREOSOTE AND ZINC CHLORIDE.—CONTINUED.

Species	Total Records		Completed Records				Unfinished Records			
	Rec.	R. R.	Number Rec.	Number Ties	Results	R. R.	Number Rec	Number Ties	Results	R. R.
ALLARDYCE, etc.										
Beech	1	1	.	..	.....	.....	1	50	9 yrs.—80% out	G. C. & S. F.
Fir, Douglas	1	1	.	..	.....	.....	1	41	8.5 yrs.—5% out	C. B. & Q.
Gum, Sweet	1	1	.	..	.....	.....	1	10	10 yrs.—65% out	G. C. & S F.
Hemlock	1	1	2	99	Avg. life 7 yrs.	G. C. & S. F.	.	....	.....	
Oak, Black	1	1	.	..	.....	.....	1	50	10 yrs.—77% out	"
Oak, Spanish	1	1	.	..	.....	.....	1	10	12 yrs.—50% out	"
Oak, Turkey	1	1	.	..	.....	.....	1	10	10 yrs.—10% out	"
Oak, White	1	1	.	..	.....	.....	1	100	10 yrs.—71% out	"
							1	10	9 yrs.—100% out	"
Oak, Willow			.	..	.....	.....	1	11	3.5 yrs.—100% out	G. C. & S. F.
Pine, Loblolly	2	1	.	..	.....	.....	2	101	9 yrs.—100% out	"
Pine, Lodgepole	1	1	.	..	.....	.....	1	77	8.5 yrs.—3% out	C. B. & Q.
Pine, Longleaf	1	1	.	..	.....	.....	1	50	10 yrs.—14% out	G. C. & S. F.
Pine, Shortleaf	1	1	.	..	.....	.....	1	50	10 yrs. 44% out	"
Tamarack	2	1	1	50	9 yrs.—100% out	G. C. & S. F.	1	51	7 yrs. 90% out	
Gum	3	1	.	..	.....	.....	3	45	9 yrs.—25-57% out	G. H. & S. A.
Oak, Black	1	1	1	76	Avg. life 1.84 yrs.	G. C. & S. F.	.	....	.....	.....
Oak, Turkey	1	1	1	10	3 yrs.—100% out	"	.	....	.....	.....
Pine	7	2	4	1894	Avg. life—14 yrs.	G. H. & S. A.	3	980	5-7 yrs.—1% out	G. H. & S. A.
Pine, Sap	3	1	.	..	.....	.....	3	1003	9 yrs.—6-52% out	"
Pine, Shortleaf	1	1	.	..	.....	.....	1	50	4 yrs.—86% out	C. M. & St. P.

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TABLE 7. EFFECTIVE DURABILITY RECORDS.—TIES TREATED BY THE WELLHOUSE PROCESS.

Species	Total Records		Completed Records				Unfinished Records			
	Rec.	R. R.	Number Rec.	Number Ties	Results	R. R.	Number Rec.	Number Ties	Results	R. R.
Beech	1	1	.	.....	.....	.....	1	100	10 yrs.—none out	G. S. & S. F.
Cottonwood	2	1	.	.....	.....	.....	2	137	12 to 15 yrs.—66-89% out	C. B. & Q.
Cottonwood, White	1	1	.	.....	.....	.....	1	49	15 yrs.—84% out	
Gum	4	1	4	250	Avg. life 12-16 yrs.	N. & S.	..	....	.....	.....
Gum, Sweet	1	1	.	.....	.....	.....	1	51	9 yrs.—80.5% out	A. T. & S. F.
Hemlock	44	5	1	21,850	Avg. life 11.8 yrs.	C. R. I. & P.	1	200	7 yrs.—none out	Pa. System
			1	200	" " 10.7 "	Pa. System	1	1287	8 yrs.—30% out	S. C. & S. R. R.
							1	100	8 yrs.—21% out	G. C. & S. F.
							39	1535	7.5 yrs.—0-5% removed	C. & N. W.
Oak, Black	2	1	.	.....	.....	.....	2	119	10 yrs.—42% out	G. C. & S. F.
Oak, Red	2	2	1	20	7 yrs.—100% out	G. C. & S. F.	1	48	9 yrs.—40% out	A. T. & S. F.
Oak, Spanish	1	1	.	.....	.....	.....	1	20	10 yrs.—45% out	G. C. & S. F.
Oak, Turkey	1	1	.	.....	.....	.....	1	20	10 yrs.—90% out	"
Oak, White	2	1	.	.....	.....	.....	2	200	10 yrs.—23% out	"
Oak, Willow	2	2	1	20	8 yrs.—100% out	G. C. & S. F.	1	35	4 yrs.—20% out	T. C. & I.
Pine, Colorado	5	1	1	50	Avg. life 11.8 yrs.	A. T. & S. F.	4	784	15.1 yrs.—37% out	A. T. & S. F.
Pine, Loblolly	1	1	.	.....	.....	.....	1	100	10 yrs.—95% out	G. C. & S. F.
Pine, Longleaf	1	1	.	.....	.....	.....	1	100	10 yrs.—55% out	"
Pine, Red Norway	1	1	1	86	Avg. life 15 yrs.	D. & I. R.	..	....	.....	.....
Pine, Shortleaf	2	2	.	.....	.....	.....	1	100	10 yrs.—80% out	G. C. & S. F.
							1	500	11 yrs.—10% out	C. M. & St. P.
Pine, White	1	1	1	85	Avg. life 15 yrs.	D. & I. R.	..	....	.....	.....
Tamarack	14	5	1	100	10 yrs.—100% out	G. C. & S. F.	1	200	7 yrs.—1% out	F. W. & C.
			1	200	Avg. life 8.8 yrs.	Pa. System	10	738	7.5 yrs.—1% out	C. & N. W.
			1	85	" " 15 yrs.	D. & I. R.	..	....	.....	.....

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1.10	Am. Ry. Eng. Ass'n. - Proceed	1911	12	380	
1.15	Letter to Forest Service	1914			Wood, W.B. - Gen. Mgr. Grand Rapids & Ind. Ry
1.25	do	1914			Clark, W.A. - Ch. Eng. D. & I.R. Ry.
1.26	do	1914			Riley, G.A. - Ch. Eng. D.L. & W. Ry.
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1.86	do	1914			Murray, O.C. - Vice Pres. Wash. Terminal Ry.
2.00	Am. Soc. Civil Eng. - Transactions	1899	42	1923 to 1971	
2.20	do	1901	45	1201 to 1268	
2.40	do	1885	14	225 to 268	
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4.00	Letters to Forest Service	1909 1912			Stimson, Earl - Ch. Eng. M. of W. B. & O. Ry.
4.10	Letter to Forest Service	1915			Angier, F.H. - Supt. Timber Preserv. B. & O. Ry.
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6.10	do	1915			Peabe, F.S. - Tie Agent C. M. & St. P. Ry.
7.00	Report and blue prints also Letter to Forest Service	1914 1915			Van Vleck - Gen. Mgr. Sunset Line Cottingham, I.A. - Asst. Gen. Mgr. G.H. & S.A. Ry.
8.00	Records - C. & E.I. Ry.	1910			Chicago Tie Preservation Co.
9.00	Report - Denials Shell & Private Rys.	1910			Collstrop, A. (Dec. 1914)
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11.00	Letters & Report to Forest Service	1911			Fox, G.E. - Mgr. Treating Plants A.T. & S.F. Ry.
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14.00	Letters to Forest Service	1912 1914			Moore, O.C. - Gen. Mgr. N.Y.C. Lines

Ref. No.	Information Obtained from	Year	Vol. Series	Page	Authority
15.00	Letter to Forest Service	1915			Osgood, J.A. - Ch. Eng. C.R.R. of N.J.
16.00	do	1914			Lamb, E.T. - Pres. Norfolk & Southern Ry.
20.00	do	1912			Peck, G.L. - Gen. Mgr. Penn. Lines West
20.10	do	1914			Foley, John - Forester Penn. Ry.
21.00	Forest Service Project No. 38				
22.00	do 41				
23.00	do 42				
24.00	do 44				
25.00	do 50				
26.00	do 51				
27.00	do 111				
29.00	Railway Gazette	1909	38	28	Schmidt - Officer in German Ry.
29.20	do	1901	33	164	Dudley, P.H.
29.40	Am. Ry. Eng. & M. of W. Assn - Proceed.	1905	6	750	
29.50	Railway Gazette	1901	35	616	Dudley, P.H.
29.60	do	1895	27	667	Schmidt - Officer in German Ry.
29.70	Railroad Gazette	1880			Tanesleher - (Proj. Con. Road, Calgary & Monday 122)
30.00	Letter to Forest Service	1912			Nixon, W.C. - Ch. Opper. Officer S.L. & S.F. Ry.
	also Report to A.R.E.A.	1914			Hendricks, V.K. - Asst. Ch. Eng. S.L. & S.F. Ry.
30.10	Letter to Forest Service	1914			Brillon, F.H. - Pres. & Gen. Mgr. St. L. & S.W. Ry.
31.00	Street Railway Journal	1898		225	Willis, D.D.
32.00	Letter to Forest Service	1912 1914			Calvin, F.E. & Scott, W.R. - Asst. Gen. Mgr. S.P. Ry.
	do	1914			Ware, Chas. - Gen. Mgr. U.P. Ry.
33.00	Am. Wood Preservers Ass'n.	1911		125	Angier, F.H. - Supt. Timber Preserv. B. & O. Ry.
33.10	Letter to Forest Service	1910			Clark, W.A. - Ch. Eng. D. & I.R. Ry.
37.00	do	1914			Ballantyne, C.B. - Mgr. Barrett Mfg. Co.
38.00	do	1914			Backes, W.J. - Eng. M. of W. N.Y.N.H. & H. Ry.
39.00	do	1914			Honolulu Rapid Transit Co.
40.00	do	1914			Davis, J.R.W. - Eng. M. of W. Grand Northern Ry.
41.00	Forest Service Project No. 126				
42.00	Letter to Forest Service	1914			Wood, B.A. - Ch. Eng. M. of W. M.P.D. Ry.
43.00	do	1914			Crawford, C.E. - Mgr. Am. Creosoting Co.
44.00	do	1915			Goshie, P.E. - Treating Insp. 1915
45.00	Letter to Forest Service	1915			Fox, G.E. - Mgr. Treating Plants A.T. & S.F. Ry.

INDEX BY PRESERVATIVE

PRESERVATIVE	PROCESS	SPECIES	Table No.
Asphalt, Timber	——	Oak, Red	20
Barium Chloride, Copper + Zinc Sulphate	Thilmany	Pine, White	25
Carbolineum	——	Fir, Oregon	9
do	——	Pine	23
do Arsenicus	——	Cedar	4
do do	——	Cypress	7
do do	——	Pine	23
do do	——	Redwood, California	27
Copper Sulphate	——	Pine	23
do	Boiled	Fir	9
do	Bonsherie	Poplar	28
do	Pressure	Fir	9
do	Steeped	Fir	9
do	do	Pine	23
do	Thilmany	Various	30
Copper + Iron Sulphate	Bouchérie	Pine, Sap	25
Copper + Zinc Sulphate, Barium Chloride	Thilmany	Pine, White	25
Coal Resinate + Coal Tar Creosote	——	Pine, Southern Yellow	25
Creosote	——	Beech	2
do	——	Cypress	7
do	——	Fir	9
do	——	Fir, Oregon	9
do	——	Gum	10
do	——	Hemlock	12
do	——	Oak	18
do	——	Oak, Mixed	18
do	——	Oak, Post	19
do	——	Oak, Red	20
do	——	Oak, White	22
do	——	Pine	23
do	——	Pine, Loblolly	24
do	——	Pine, Longleaf	25
do	——	Pine, Shortleaf	26
do	——	Pine, Southern Yellow	25
do	——	Pine, Yellow	25
do	——	Various	30
do	Rueping	Gum, Red	10
do	do	Oak	18
do	Full Cell	Ash	1
do	do	Beech	2
do	do	Birch, Red	5

PRESERVATIVE	PROCESS	SPECIES	Table No.
Creosote	Full Cell	Cypress	7
do	do	Elm, White	8
do	do	Fir, Red	9
do	do	Fir, Douglas	9
do	do	Gum, Red	10
do	do	Gum, Tupelo	11
do	do	Hemlock	12
do	do	Hickory, Pignut	13
do	do	Juniper	14
do	do	Maple	15
do	do	Maple, Hard	16
do	do	Maple, Soft	17
do	do	Oak, Bur	18
do	do	Oak, Red	20
do	do	Oak, White	21
do	do	Pine	23
do	do	Pine, Heart	24
do	do	Pine, Loblolly	24
do	do	Pine, Ladgepole	25
do	do	Poplar	28
do	do	Redwood, Pacific	27
do	do	Spruce	27
do	do	Sycamore	28
do	do	Tamarack	29
do	Rinesani	Gum, Red	10
do	do	Oak, Red	20
do	do	Pine	23
do	Hayford	Pine, Virginia	25
do	Low Steam and Superheated Cells	Gum, Red	10
do	Lowry	Beech	2
do	do	Chestnut	6
do	do	Gum	10
do	do	Oak	18
do	do	Pine	23
do	do	Pine, Ladgepole	25
do	Low Pressure	Chestnut	6
do	do	Oak, Red	20
do	do	Pine	23
do	No Steaming	Gum, Red	10
do	Open Tank	Fir, Douglas	9
do	do	Hemlock	12
do	do	Tamarack	29
do	Burnettizing	Ash	1

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Creosote	Empty	Beech	8
〃	〃	Fir, Douglas	9
〃	〃	Fir, Red	9
〃	〃	Gum	10
〃	〃	Gum, Red	10
〃	〃	Maple	15
〃	〃	Oak, Red	20
〃	〃	Pine	23
〃	〃	Pine, Loblolly	24
〃	〃	Pine, Lodgepole	25
〃	〃	Pine, Shortleaf	25
〃	Soaky	Hemlock	12
〃	Steaming	Pine, Shortleaf	25
〃 Coal Tar	—	Pine, Shortleaf	25
〃 Wood Tar	—	Chestnut	8
〃 〃	—	Gum	10
〃 〃	—	Oak, Pin	19
〃 〃	—	Oak, Red	20
〃 〃	—	Oak, White	22
〃 〃	—	Pine, Burl	23
〃 〃	—	Pine, Georgia Yellow	25
〃 〃	—	Pine, Pitch	25
〃 〃	—	Poplar	10
〃 〃	Brush	Oak, White	22
〃 〃	〃	Pine, Georgia Yellow	25
〃 〃	Dipped	Chestnut	8
〃 〃	〃	Oak, Chestnut	18
〃 〃	〃	Oak, Red	20
〃 〃	〃	Oak, White	22
〃 and Crude Oil	—	Beech	8
〃 〃	—	Oak, Red	20
〃 and Crude Asphaltic Oil	—	Oak, Red	20
Creosote, Coal Tar and Zinc Chloride	—	Pine, Southern Yellow	25
Dowel Calcium	—	Pine, Shortleaf	25
〃	Low Pressure	Pine	23
〃	No Steaming	Elm	8
〃	〃	Maple	15
Diamond Blue Preservative	—	Pine	23
Diamond Wood Preserver	—	Gum, Red	10
〃	—	Oak, Red	20
〃	—	Pine, Jap	25
Liquid, J. M. Lang's	—	Beech	8
〃	—	Oak, Red	20

Liquid, J. M. Lang's	—	Pine, Loblolly	24
Mercuric Chloride	Kyan	Hemlock	12
〃	〃	Oak	18
〃	〃	Pine	23
〃	〃	Spruce	23
〃	〃	Various	20
〃	Pressure	Various	20
Oil + Zinc Chloride	—	Pine, Longleaf	25
Oil, Bethell	—	Pine, Loblolly	24
〃	—	Pine, Mountain	25
〃	—	Pine, Shortleaf	25
〃 + Zinc Chloride	Burnett	Pine, Mountain	25
Oil, Beaumont	—	Pine, Loblolly	24
〃	—	Pine, Longleaf	25
〃 + Zinc Chloride	—	Pine, Loblolly	24
Oil, California + 〃	—	Redwood, California	22
Oil, Crude	—	Beech	8
〃	—	Cypress	9
〃	—	Elm, White	8
〃	—	Maple, Soft	12
〃	—	Oak, Red	20
〃	—	Various	20
〃	Boiled	Gum	10
〃 + Zinc	—	Hemlock	12
〃 〃	—	Tamarack	20
Oil, Crude Asphaltic	—	Oak, Red	20
Oil, Fuel	Low Pressure	Chestnut	8
〃	〃	Oak, Red	20
Oil, Semi-refined	Full Cell	Maple	15
〃	〃	Oak, Red	20
Salts, Barschall	Hasselmann	Beech	8
〃	〃	Fir	9
〃	〃	Hemlock	12
〃	〃	Oak, Black	18
〃	〃	Oak, Red	20
〃	〃	Oak, Spanish	21
〃	〃	Oak, Turkey	21
〃	〃	Oak, White	22
〃	〃	Oak, Willow	22
〃	〃	Pine	23
〃	〃	Pine, Loblolly	24
〃	〃	Pine, Longleaf	25
〃	〃	Pine, Shortleaf	25

Preservative	Process	Species	Table No.
Salts, Burnettized	Hasselmann	Tamarack	29
Salts, Great Salt Lake	Soaked	Fir, Oregon	9
Spirit fire	—	Pine, Loblolly	24
"	—	Pine, longleaf	25
Tar	—	Various	30
Terada Proof Paint	—	Pine, Yellow	25
Timbar Asphalt	—	Oak, Red	20
Unknown	—	Cedar	4
"	—	Fir	9
"	—	Gum, Red	10
"	—	Oak, Black	18
"	—	Various	30
Untreated	—	Ash	1
"	—	Beech	2
"	—	Birch, Red	3
"	—	Cedar	4
"	—	Chestnut	5
"	—	Cottonwood	6
"	—	Cypress	7
"	—	Cypress, Red	7
"	—	Cypress, Yellow	7
"	—	Elm, White	8
"	—	Fir	9
"	—	Fir, Douglas	9
"	—	Fir, Oregon	9
"	—	Gum, Red	10
"	—	Gum, Tupelo	11
"	—	Hemlock	12
"	—	Hemlock, Western	12
"	—	Hickory, Pignut	13
"	—	Juniper	14
"	—	Larch, Western	15
"	—	Maple	16
"	—	Maple, Hard	16
"	—	Maple, Soft	17
"	—	Oak	18
"	—	Oak, Black	18
"	—	Oak, Chestnut	18
"	—	Oak, Danish	18
"	—	Oak, Mississippi White	21
"	—	Oak, Pin	19
"	—	Oak, Post	19
"	—	Oak, Red	20
"	—	Oak, Spanish	21
"	—	Oak, Swedish	21
"	—	Oak, Tennessee White	21
"	—	Oak, Turkey	21
"	—	Oak, White	22
"	—	Oak, Willow	22
"	—	Pine	23
"	—	Pine, Bottle	23

Preservative	Process	Species	Table No.
Untreated	—	Pine, Dantzic	23
"	—	Pine, Heart	23
"	—	Pine, Loblolly	24
"	—	Pine, Lodgepole	25
"	—	Pine, Longleaf	25
"	—	Pine, Riga	25
"	—	Pine, Shortleaf	25
"	—	Pine, Swedish	25
"	—	Pine, Western Yellow	25
"	—	Pine, White	25
"	—	Pine, Yellow	25
"	—	Poplar	26
"	—	Spruce	27
"	—	Sycamore	28
"	—	Tamarack	29
Various	—	Fir	9
"	—	Pine	23
Vulcanized	—	Gum	10
"	—	Pine	23
"	Heat + Pressure	Various	30
Woodiline	Dipped	Pine, Longleaf	25
"	Painted	Pine, Longleaf	25
Zinc + Crude Oil	—	Hemlock	12
"	—	Tamarack	29
Zinc Chloride	—	Ash	1
"	—	Beech	2
"	—	Fir	9
"	—	Fir, Douglas	9
"	—	Fir, Oregon	9
"	—	Oak	18
"	—	Pine, Black hills	23
"	—	Pine, Loblolly	24
"	—	Redwood, Baltic	27
"	Boiled	Fir, Douglas	9
"	"	Fir, Grand	9
"	"	Oak, Red	20
"	"	Pine, Lodgepole	25
"	"	Pine, Longleaf	25
"	"	Pine, Shortleaf	25
"	Burnett	Beech	2
"	"	Birch	3
"	"	Chestnut	5
"	"	Cypress	7
"	"	Elm, White	8

Preservative	Process	Species	Table No.
Zinc Chloride	Burnett	Fir	9
do	do	Fir, Douglas	9
do	do	Fir, Oregon	9
do	do	Fir, Red	9
do	do	Gum	10
do	do	Gum, Red	10
do	do	Gum, Tupelo	11
do	do	Hackberry	11
do	do	Hemlock	12
do	do	Hickory, Pignut	13
do	do	Larch, Western	14
do	do	Maple, Hard	16
do	do	Maple, Soft	17
do	do	Oak	18
do	do	Oak, Black	18
do	do	Oak, Pin	19
do	do	Oak, Red	20
do	do	Oak, Turkey	21
do	do	Oak, Water	21
do	do	Oak, White	22
do	do	Oak, Willow	22
do	do	Pine	23
do	do	Pine, Loblolly	24
do	do	Pine, Lodgepole	25
do	do	Pine, Longleaf	25
do	do	Pine, Mountain	25
do	do	Pine, Sap	25
do	do	Pine, Shortleaf	25
do	do	Poplar	26
do	do	Redwood, California	27
do	do	Spruce	27
do	do	Sycamore	28
do	do	Tamarack	29
do	do	Various	30
do	Impregnated	Larch	14
do	Pressure	Beech	2
do	Steeping	Pine	23
Zinc Chloride + Oil	——	Pine, Longleaf	25
do + Bakersfield Oil	Burnett	Pine, Mountain	25
do + Beaumont Oil	——	Pine, Loblolly	24
do + California Oil	——	Redwood, California	27

Preservative	Process	Species	Table No.
Zinc Creosote	——	Oak	18
do	——	Oak, Black	18
do	——	Oak, Turkey	21
do	——	Pine	23
do	——	Pine, Sap	25
do	——	Pine, Shortleaf	25
do	——	Various	30
do	Allardyce	Beech	2
do	do	Gum, Sweet	10
do	do	Fir, Douglas	9
do	do	Fir, Red	9
do	do	Hemlock	12
do	do	Oak, Black	18
do	do	Oak, Spanish	21
do	do	Oak, Turkey	21
do	do	Oak, White	22
do	do	Oak, Willow	22
do	do	Pine, Loblolly	24
do	do	Pine, Lodgepole	25
do	do	Pine, Longleaf	25
do	do	Pine, Shortleaf	25
do	do	Tamarack	29
do	Beaumont	Oak, White	22
do	do	Pine, Longleaf	25
do	Card	Ash	1
do	do	Beech	2
do	do	Birch, Red	3
do	do	Chestnut	5
do	do	Cottonwood	6
do	do	Cypress	7
do	do	Elm, White	8
do	do	Gum, Red	10
do	do	Gum, Tupelo	11
do	do	Hackberry	11
do	do	Hemlock	12
do	do	Hickory, Pignut	13
do	do	Maple	15
do	do	Maple, Hard	16
do	do	Maple, Soft	17
do	do	Oak, Pin	19
do	do	Oak, Red	20

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Preservative	Process	Species	Plate No.
Zinc Creosote	Card	Poplar	21
"	"	Sycamore	29
"	"	Tamarack	24
"	Giussani	Pine	25
"	Low Pressure	Oak, Red	26
"	Rutgers	Beech	1
"	Two Payment	Maple	15
Zinc-Copper Sulphate, Bonnie Chloride	Tripmeny	Pine, White	25
Zinc Tannate	Wellhouse	Ash	1
"	"	Beech	2
"	"	Cedar	4
"	"	Cottonwood	5
"	"	Cottonwood, White	6
"	"	Fir	8
"	"	Gum	10
"	"	Gum, Sweet	11
"	"	Hemlock	12
"	"	Maple	15
"	"	Oak, Black	18
"	"	Oak, Red	20
"	"	Oak, Spanish	21
"	"	Oak, Turkey	21
"	"	Oak, White	22
"	"	Oak, Willow	22
"	"	Pine, Colorado	23
"	"	Pine, Loblolly	24
"	"	Pine, Longleaf	25
"	"	Pine, Mountain	25
"	"	Pine, Red Norway	25
"	"	Pine, Sap	25
"	"	Pine, Shortleaf	25
"	"	Pine, White	27
"	"	Tamarack	27
"	"	Various	30

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Index Number	Date Planted	Form	Seasoning	Average Size	No. of Type	Number Killed	Date Planted	Locality	Contractor Name	Ballast	Quality of Soil	Date Inspected	Spikes	Tie Plates	Traffic	Date of Last Treating	Time in Service	% Found Defective	Character of Defects	Rail Cutting	Tie Life in Years	Remarks	Per Cent Renewed
											TABLE 1 - ASH												
CREOSOTE - FULL CELL																							
1.1	—	—	—	19	—	9.62	1910	Lines East	C.B.&Q.	Sheridan	—	90	—	All	—	1910	4	0	—	—	—	—	5.00
1.2	—	—	—	1	—	9.62	1909	Lines West	do	Gravel & Clay and Cinders	—	85	—	Yes	—	do	5	0	—	—	—	—	5.00
1.3	—	—	—	15	—	9.62	1910	do	do	Lyons Shore	Very Dry	90	—	do	—	do	4	0	—	—	—	—	5.00
CREOSOTE - RUMPING																							
2.1	—	—	Well Seasoned	274	—	5.00	1909	Fulton, Ky	I.C.	Gravel	—	90	—	Economy	—	1913	4	0	—	Good	—	Continuous angle bars	12.00
2.2	—	—	do	274	—	5.00	1910	Greenville, Miss	do	Dirt	—	75	—	do	—	do	3	0	—	do	—	Weber Joints	12.00
UNTREATED																							
3.1	—	—	—	96	—	—	1909	Lines East	C.B.&Q.	Crushed Gravel Gravel Clay	—	75-85 90	—	Yes	—	1910	5	76	Rot	—	—	—	5.00
3.2	—	—	—	19	—	—	1910	do	do	Gravel	—	90	—	All	—	do	4	12.8	do	—	—	—	5.00
3.3	—	—	—	30	—	—	1909	Lines West	do	Crushed Gravel Sand Gravel Clay	—	75-85 90	—	Yes	—	do	5	76.7	do	—	—	—	5.00
3.4	—	—	—	15	—	—	1910	do	do	Lyons Shore	—	90	—	do	—	do	4	82.0	do	—	—	50% show checking	5.00
ZINC CHLORIDE																							
4.1	—	—	—	16	—	0.5	1910	Lines East	C.B.&Q.	Gravel	—	90	—	All	—	1914	4	0	—	—	—	—	5.00
4.2	—	—	Seasoned - Yes	15	—	0.5	1910	Lines West	do	Lyons Shore	—	90	—	Yes	—	do	4	0	—	—	—	—	5.00
4.3	—	—	Seasoned	275	—	0.5	1909	Hamilton, Ill.	I.C.	Old Rock	—	90	—	1 Tin plate Economy	—	1913	4	0	—	Good	—	Continuous angle bars	12.00
4.4	—	—	do	274	—	0.5	1910	Bloomington, Ill.	do	Old Gravel	—	75	—	1 Tin plate Economy	—	do	3	0	—	do	—	Weber Joints	12.00
4.5	—	—	do	274	—	0.5	1909	Fulton, Ky	do	do	—	90	—	2 Tin plate Economy	—	do	4	0	—	do	—	Continuous angle bars	12.00
4.6	—	—	do	274	—	0.5	1910	Lula, Miss.	do	New Gravel	—	75	—	2 Tin plate Economy	—	do	3	0	—	—	—	40° angle bars	12.00
4.7	—	—	do	274	—	0.5	1910	Greenville, Miss.	do	Dirt	—	75	—	1 Tin plate Economy	—	do	3	1.0	Broken	Good	—	Weber Joints 15% decayed	12.00
ZINC CREOSOTE - CARD																							
5.1	—	—	—	148	—	0.5 Zinc 2.0 Creosote	1909	Lines East	C.B.&Q.	Crushed Gravel Gravel Clay	—	75-85 90	—	Partly	—	1914	5	0	—	—	—	—	5.00
5.2	—	—	—	125	—	do	1910	do	do	Gravel	—	90	—	do	—	do	4	0	—	—	—	—	5.00
5.3	—	—	—	98	—	do	1909	Lines West	do	Crushed Gravel Gravel Clay	—	75-85 90	—	Yes	—	do	5	0	—	—	—	—	5.00
5.4	—	—	—	15	—	do	1910	do	do	Lyons Shore	—	do	—	do	—	do	4	0	—	—	—	—	5.00
ZINC TANNIN - WELLHOUSE																							
6.1	—	—	—	—	—	—	1886	Santa Fe, N.M.	U.P.	—	—	—	—	—	—	1915-8	9-12	100	—	—	—	Began to fail in 1893	2.00
											TABLE 2 - BEECH												
CREOSOTE																							
1.1	—	—	—	1000-2000	7.12 - 5.96	—	1885-6	Prussia	Imperial R.R.	—	—	Poor	—	—	—	1915-6	10	63	Decay	—	—	—	29.00
1.2	—	—	—	do	do	—	do	do	do	—	—	Good	—	—	—	do	10	0	—	—	—	—	do
1.3	6½"×10"×8'-10"	—	—	4000	—	—	—	Germany	do	—	—	—	—	—	—	—	—	—	—	—	—	—	do
1.4	do	—	—	—	66.0	—	—	do	Union Ry	—	—	—	—	—	—	1896	—	—	—	—	—	—	12.00
1.5	do	—	—	—	79.2	—	—	do	do	—	—	—	—	—	—	—	—	—	—	—	—	—	do
1.6	—	—	—	21440	—	—	1885	do	Odessa & Russian	—	—	—	—	—	—	1880	20	46.9	—	—	—	—	29.70
1.7	—	—	—	—	—	—	—	France	—	—	—	—	—	—	—	1895	—	—	—	—	—	—	10.10
1.8	—	—	—	—	—	6.8	1907	—	C.R.I.&P.	—	—	—	—	—	—	1908	1	—	—	—	—	—	1.00
1.9	—	—	—	—	—	—	—	Germany	Siemens R.R.	—	—	—	—	—	—	—	—	—	—	—	30	—	2.00
CREOSOTE - FULL CELL																							
2.1	—	—	—	206	—	11.12	1909	Lines East	C.B.&Q.	Crushing gravel Gravel Clay	—	75-85 90	—	Partly	—	1914	5	0	—	—	—	—	5.00
2.2	—	—	—	99	—	do	1910	do	do	Gravel	—	90	—	do	—	do	4	0	—	—	—	—	do
2.3	—	—	—	119	—	do	1909	Lines West	do	Crushed Gravel Gravel Clay	—	75-85 90	—	Yes	—	do	5	0	—	—	—	—	do
2.4	—	—	—	44	—	do	1910	do	do	Lyons Shore	—	90	—	do	—	do	4	0	—	—	—	—	do

21800 Copyright

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
2.5	7'-9"-8'-6	Seasoned	Seasoned	220	2.5 Gal	0.875 Gal	1911	Winslow, Ala	B.L.Y.R.	Stone	do	191	do	do	Galvanized Barbed Wire	Nailed	1913	4	0	—	—	—	Includes Cleats	3.75
2.6	do	—	Seasoned	255	—	—	1908	Hamilton Miss	do	do	do	191	do	do	Galvanized Crimped Fencing	—	do	7	—	—	—	—	Includes Brace + Angle	4.00
2.1	8.1'-8.2'-8.5'	—	Seasoned 6 mo.	356630	ST-66	—	—	France	Creosoting	—	—	Steel Cells	140 Cubic Feet	—	—	—	—	—	—	—	25-30	Wear	5.20
	CREOSOTE - LOWRY																						
@ 3.1	—	—	—	6288	2.5 Gal	—	1910	Buffalo, N.Y.	N.Y.C	Stone + Gravel	—	80 to 100	Cut	17% Nickel	Heavy	1912	2	0	—	—	—	Treated with Hooper Wrought middle	14.00
@ 3.2	—	—	—	7488	do	—	do	Erie, Pa.	do	Cinders	—	80	do	None	do	do	do	0	—	—	—	do	14.00
@ 3.3	—	—	—	7964	do	—	do	Sandusky, Ky	do	Gravel	—	80 to 100	do	do	do	do	do	0	—	—	—	do	14.00
@ 3.4	—	—	—	5706	do	—	do	Norwalk Ohio	do	Cinders	—	do	do	65% Nickel	—	do	do	0	—	—	—	Treated with Hooper Wrought middle	14.00
@ 3.5	—	—	—	6000	do	—	do	Air Line Ohio	do	Gravel	—	80	do	None	—	do	do	0	—	—	—	do	14.00
@ 3.6	—	—	—	6000	do	—	do	Elkhart Ohio	do	do	—	65	do	Yes	—	do	do	0	—	—	—	Treated with Hooper Wrought middle	14.00
@ 3.7	6'-8"-8'	—	Seasoned	5000	2.75	—	1911	Shreveport	L.S.H.C.	Stone	Good	80	—	None	Heavy	do	1	0	—	—	—	do	5.10
@ 3.8	7'-9"-8'-6	—	Seasoned 6 mo.	812	3 Gal	—	1913	Pelham, Ala	D.L.Y.W	do	do	101	Screw	D.L.Y.W	—	do	1915	2	0	0	0	0	Includes Bevel + Angle
3.9	do	—	do	159000	2.5 Gal	—	1910-11	D.L.Y.W	do	do	do	101	Screw	do	—	do	1914	2	0	—	—	—	Includes Bevel + Angle, Sap Pine, Gum Elm, Red Oak	4.00 do
3.1	CREOSOTE AND CRUDE OIL			5	—	—	1911	Decatur, Ill	C.B.+Q	Gravel	—	75	—	Hot creosote under pressure	—	1912	—	0	—	—	—		5.00
	CREOSOTE - KREPPING			See ASH for No 1-2.1																			
@@ 5.1	—	—	Seasoned	274	—	5	1909	Lula, Miss.	I.C.	Gravel	—	75	—	Galvanized	—	1912	3	—	—	—	—	40" Tudor bars	12.00
@ 5.2	—	—	—	248	—	—	1910	Bloomington, Ill	I.C	Old Gravel	—	75	—	do	—	1912	3	0	—	Good	—	Weber angle bars	12.00
	LIQUID - JAMES JONES																						
@ 6.1	—	—	Seasoned	49	—	0.287	1910	Greenville, Miss	I.C.	Dirt	—	75	—	Galvanized	—	1913	—	0	—	Fair	—	Show 8 cans of surface decay	12.00
	OIL - CRUDE																						
7.1	—	—	—	6	—	—	1911	Bastrop, La	C.B.+Q	Gravel	—	75	—	Hot creosote under pressure	—	1912	1	0	—	—	—		5.00
	SALTS (BARSCHALL - HASSELMANN)																						
@ 8.1	—	—	—	99	—	—	1902	Pelican, Tex.	G.C.+S.F.	Sand	Poor	60	Cut	—	Heavy	1905	3.75	100	—	—	3	Started to fail in 1904	11.00
	UNTREATED																						
9.1	—	—	—	110	—	—	1909	Lima East	C.B.+Q	Cinders Gravel Gravel Top	—	75-85 90	—	Partly	—	1914	5	21.2	—	—	—		5.00
9.2	—	—	—	23	—	—	1910	do	do	Gravel	—	90	—	do	—	do	4	20.1	—	—	—		5.00
9.3	—	—	—	58	—	—	1909	Lima West	do	Cinders Gravel Gravel Top	—	75-85 90	—	Yes	—	do	5	71.0	—	—	—		5.00
9.4	—	—	—	15	—	—	1910	do	do	do	—	do	—	do	—	do	4	0	—	—	—		5.00
@ 9.5	—	—	—	109	—	—	1902	Beaumont, Tex.	G.C.+S.F.	Sand	Poor	60	Cut	None	Heavy	1905	4.25	100	—	—	Total	97% out in 1905	11.00
	ZINC CHLORIDE																						
10.1	—	—	—	200 to 3000	PAT. 37.6	—	1885-6	Pretoria	Aspen. R.R.	—	Poor	—	—	—	—	1886	10	41	Rot	—	—		28.00
10.2	—	—	—	do	do	—	do	do	do	—	Good	—	—	—	—	do	10	22.5	do	—	—		28.00
10.3	—	—	—	—	44	—	—	Switzerland	Harvard Bot Garden	—	—	—	—	—	—	—	—	—	—	—	10	Life untreated 2 to 3 Years	2.00
10.4	—	—	—	—	—	—	—	Germany	Aspen R.R	—	—	—	—	—	—	—	—	—	—	—	9	Ground Shelterwood	do
10.5	—	—	—	4000	—	—	do	do	do	—	—	—	—	—	—	—	—	—	—	—	21	Based on renewals to 1897	28.00
	ZINC CHLORIDE - BURNETT																						
11.1	—	—	—	105	—	0.5	1909	Lima East	C.B.+Q	Cinders Gravel Gravel Top	—	75-85 90	—	Partly	—	1914	5	2.0	Rot	—	—		5.00
11.2	—	—	—	104	—	do	1910	do	do	Cinders	—	90	—	All	—	do	4	0	—	—	—		5.00
11.3	—	—	—	60	—	do	1909	Lima West	do	Cinders Gravel Gravel Top	—	75-85 90	—	Yes	—	do	5	1.67	—	—	—		5.00
11.4	—	—	—	44	—	do	1910	do	do	Lima Shale	—	90	—	do	—	do	4	0	—	—	—		5.00
11.5	—	—	—	99	—	0.41	1902	Beaumont, Tex.	G.C.+S.F.	Sand	—	60	Cut	None	Heavy	1912	10	76	—	—	—	Began to fail 1914	11.00
11.6	—	—	—	5,276,173	—	0.5	1903	—	I.C.	—	—	—	—	—	—	1908	5	0	—	—	Total	Includes cut	4.00
11.7	—	—	—	9957	—	—	1901	Pillsbury, Pa.	Pa. Lines	—	—	—	—	—	—	1905	5	0	—	—	—		1.30
11.8	—	—	—	13,835	—	—	1902	do	do	—	—	—	—	—	—	do	4	0	—	—	—		1.30
11.9	—	—	—	—	36 Gal	—	—	Germany	Main Ry.	—	—	—	—	—	—	1895	—	—	—	—	9		12.00
11.10	6'-8"-8'	Sound	Air Seasoned	500	—	0.5	1911	Hinesville, Miss	C.R.I.&P.	Gravel	Good	90	Cut	None	Heavy	1915	4	0.2	—	—	Good	Unseasoned - broken	6.00

① - Includes Maple and Red Oak
② - Includes Gum and Elm - Pressure 75 # for 30 Min - Maximum Pressure 175# for 2 Hours - Final Vacuum 24 inch for 20 Min.
③ - Includes Chestnut, Elm and Gum
④ - Pumped by steam power

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3.1	[illegible]	—	—	—	—	8.00	1908	[illegible]	Erwin	—	—	—	—	—	—	1906	10	—	—	[illegible]	—	[illegible]	4.00
4.1	CREOSOTE-COAL TAR MIXTURE	—	—	—	—	—	1905	Brunswick, Mo.	Atlantic	—	—	—	—	—	—	1905	10	100	—	—	—	Brunswick 1909 - No further data	30.00
4.1	CARBOLINEUM - AVENARIUS	—	—	Seasoned	—	—	—	1909	Honolulu	Honolulu Rapid Transit Co.	—	—	—	—	Yes	—	1909	5-8	—	—	—	—	Many creosoted spots below	39.00
	TABLE 5 - CHESTNUT																						
1.1	CREOSOTE - FULL CELL																						
1.2	7'-9"-8.6"	—	—	Steamed	88	—	—	1907	Evanston, Ill.	D.L.&W.	Stone	Good	101	Good	Wallington	—	1915	8	—	—	—	—	—	44.00
	do	—	—	—	95	—	—	do	do	do	do	do	101	do	do	—	do	8	—	—	—	—	do	do
2.1	CREOSOTE - LOWRY																						
	7'-9"-8.6"	—	—	Seasoned	733	3.5 Gal	—	1912	Bellevue, Ill.	D.L.&W.	Stone	Good	101	Stone	D.L.&W.	—	1915	3	0	—	—	—	—	44.00
2.1	CREOSOTE - LOW PRESSURE																						
	—	New	Seasoned	32	3.5 Gal	8.5	1910	Dover, N.J.	Lackawanna	—	—	—	—	Yes & Wenger	—	1911	1	0	—	—	—	—	22.00
4.1	OIL - FUEL - LOW PRESSURE																						
	—	New	Seasoned	278	2.2 Gal	6.7	1910	do	do	—	—	—	—	do	—	do	1	0	—	—	—	—	do
5.1	UNTREATED																						
5.2	—	—	—	165	—	—	1909	Lucas East	C.B.&Q.	Cowden Ground Burnt Clay	—	75-85	—	Partly	—	1914	5	14.8	Partly Rot	—	—	—	5.00
5.3	—	—	—	90	—	—	do	Lucas West	do	do	—	do	—	Yes	—	do	5	13	Shaky	—	—	—	do
5.4	—	—	—	4,237,655	—	—	Various	N.J. & Penn.	L.R.&N.J.	—	—	—	—	do	—	1907-9	—	12.5	—	—	—	Includes Oak & Yellow Pine	1.10
5.5	—	—	—	21,280	—	—	1905	Kentucky	I.C.	—	—	—	—	—	—	1910	4-5	12.0	—	—	4.0	do	do
5.6	—	—	—	5760	—	—	1897	Penn.	P.R.R.	—	—	—	—	—	—	do	13	12.0	—	—	11.00	Includes Oak & Yellow Pine	1.10 & 11.00
5.6	—	—	—	2816	—	—	1908	do	do	—	—	—	—	—	—	do	7	8.0	—	—	6.5	do	do
5.7	7'-9"-8.6"	—	Steamed	16	—	—	1912	Bellevue, Ill.	D.L.&W.	Stone	Good	101	Stone	D.L.&W.	—	1915	3	—	—	—	—	—	44.00
	WOOD TAR CREOSOTE - DIPPED 1 HOUR																						
6.1	—	—	—	2	—	—	1906	Nevada, Mo.	M. Lines	—	—	—	—	—	—	1914	—	—	Dry Rot	—	13	—	20.10
	WOOD TAR CREOSOTE																						
7.1	—	—	—	32	—	—	1906	Nevada, Mo.	M. Lines	—	—	—	—	—	—	1914	—	—	Dry Rot	—	5.5	Includes Oak & Yellow Pine	20.10
	ZINC CHLORIDE - BURNETT																						
8.1	—	—	—	21	—	8.5	1911	Hartford, Mo.	C.M.&St.P.	Ground	Good	90	Stone	Yes	Heavy	1914	3	0	—	—	—	4.0 & Partly decayed Spikes 13.00	Heavy 27.00
	ZINC CREOSOTE - CARD																						
9.1	—	—	—	165	—	8.5 Zinc 30 Creo	1909	Lucas East	C.B.&Q.	Cowden Ground Burnt Clay	—	75-85	—	Partly	—	1914	5	12.2	Partly Rot	—	—	—	5.00
9.2	—	—	—	89	—	do	do	Lucas West	do	do	—	do	—	Yes	—	do	5	11.0	do	—	—	—	do
	TABLE 6 - COTTONWOOD																						
	CREOSOTE FULL CELL																						
1.1	—	—	—	85	—	9.96	1909	Lucas East	C.B.&Q.	Cowden Ground Burnt Clay	—	75-85	—	Partly	—	1914	5	0	—	—	—	—	5.00
1.2	—	—	—	37	—	do	do	Lucas West	do	do	—	do	—	Yes	—	do	5	0	—	—	—	—	do
	UNTREATED																						
2.1	—	—	—	56	—	—	do	Lucas East	do	do	—	do	—	Partly	—	do	5	9.4.6	Rot	—	—	—	do
2.2	—	—	—	30	—	—	do	Lucas West	do	do	—	do	—	Yes	—	do	5	11.0	do	—	—	—	do
	ZINC CREOSOTE - CARD																						
3.1	—	—	—	286	—	8.5 Zinc 30 Creo	do	Lucas East	do	do	—	do	—	Partly	—	do	5	11.0	—	—	—	—	do
3.2	—	—	—	160	—	do	do	Lucas West	do	do	—	do	—	Yes	—	do	5	11.35	—	—	—	—	do
	ZINC TANNIN - WELLHOUSE																						
4.1	—	—	—	87	—	—	1912	Topeka, Kas.	A.T.&S.F.	—	—	—	—	—	—	1913	14.0	12.5	Rot	—	11-12	12 Ozs. Zinc untreated	8.00
4.2	—	—	—	50	—	do	do	La Junta, Colo.	do	do	—	—	—	—	—	1907	15	6.8.0	do	—	—	Several destroyed by moths	do
	COTTONWOOD, WHITE																						
	ZINC TANNIN - WELLHOUSE																						
5.1	—	—	—	49	—	—	do	La Junta, Colo.	A.T.&S.F.	—	—	—	—	—	—	1907	15	8.4	Rot	—	—	—	2.00
	TABLE 7 - CYPRESS																						

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	ZINC CHLORIDE - PRESSURE																						
12.1	—	—	—	81002	—	—	1852	Germany	Hanover	—	—	—	—	—	—	1867	15	345	Dorsey	—	14.8	—	240, 2710
12.2	—	—	—	680	—	—	do	do	Denmark	—	—	—	—	—	—	do	15	420	do	—	13	—	do
	ZINC CREOSOTE - ALLARDYCE																						
13.1	—	—	—	50	—	4.86 Zinc 2.0 Creo.	1902	Beaumont, Tex.	G.C.+S.F.	Sand	Poor	60	Cut	None	Heavy	1912	10	80	—	—	—	80% removed 1911	11.00
	ZINC CREOSOTE - CARD																						
14.1	—	—	—	439	—	0.5 Zinc 2.0 Creo.	1909	Lucas East	C.B.+Q.	Chalybeate Sheridan Chalk	—	90	—	Partly	—	1914	5	64	—	—	—	—	5.00
14.2	—	—	—	370	—	do	1910	do	do	Sheridan Gravel	—	90	—	All	—	do	4	0	—	—	—	—	5.00
14.3	—	—	—	37	—	do	1911	do	do	do	—	95	—	Yes	—	do	3	0	—	—	—	—	5.00
14.4	—	—	—	240	—	do	1909	Lucas West	do	Chalybeate Gravel Sand Clay	—	90	—	do	—	do	5	0	—	—	—	—	5.00
14.5	〃	—	—	177	—	do	1910	do	do	Lyons Shore	—	90	—	do	—	do	4	0	—	—	—	—	5.00
14.6	7'9"×8.5'	Sawed	Partial Air Seasoned	1107	—	0.5 Zinc 2.0 Creo.	1911	Windsor, Ohio	B.+O.	Gravel	Good	90	Cut	Shoulder Always	Heavy	1915	4	0	—	—	—	Includes Gum	4.00
14.X1	6×8×8	Sawed	Air Seasoned	344	—	do	1912	Lake, Wis.	C.M.+St.P.	Cinder	do	85	do	None	Average	1914	3	0	—	—	—	Beech - Sawed Sound Heart	6.00
	ZINC CREOSOTE - NUTGERS																						
15.1	—	—	—	58	—	0.33 Zinc	1908	Beaumont, Tex.	G.C.+S.F.	Sand	Poor	60	Cut	None	Heavy	1908	8	100	—	—	6	All removed in 1908	11.00
	ZINC TANNIN - WELLHOUSE																						
16.1	—	—	—	100	—	0.87	1902	do	do	Sand	Poor	60	Cut	None	Heavy	1912	10	0	—	—	—	16 Partially decayed	11.00
								TABLE 3 - RED BIRCH														
	CREOSOTE FULL CELL																						
1.1	—	—	—	45	—	—	1910	Hanover, Ill.	C.B.+Q.	Sheridan Gravel	—	90	—	All	—	1914	4	0	—	—	—	—	5.00
1.2	—	—	—	30	—	—	do	Blending, Ill.	do	do	—	do	—	do	—	do	4	0	—	—	—	—	5.00
1.3	—	—	—	14	—	—	1911	Radom, Ill.	do	Gravel	—	95	—	Except Sand Hills	—	do	3	0	—	—	—	—	5.00
1.4	—	—	Seasoned 1yr. after treatment	59	—	—	1910	Barr, Colo.	do	Lyons Shore	Very Dry	90	—	Yes	—	1912	2	0	—	—	—	—	5.00
	UNTREATED																						
2.1	—	—	—	91	—	—	1909	Lucas East	C.B.+Q.	Chalybeate Gravel Sand Clay	—	90	—	Partly	—	1914	5	100	—	—	—	Avg. Life Less than 4 yrs.	5.00
2.2	—	—	—	49	—	—	1910	do	do	Sheridan Gravel	—	90	—	All	—	do	4	do	—	—	—	do	5.00
2.3	—	—	—	48	—	—	1909	Lucas West	do	Chalybeate Gravel Sand Clay	—	90	—	Yes	—	do	5	do	—	—	—	do	5.00
2.4	—	—	—	30	—	—	1910	do	do	Lyons Shore	—	90	—	do	—	do	4	96	—	—	—	do	5.00
	ZINC CHLORIDE - BURNETT																						
3.1	—	—	—	45	—	0.5	1910	Hanover, Ill.	C.B.+Q.	Sheridan Gravel	—	90	—	All	—	1914	4	0	—	—	—	—	5.00
3.2	—	—	—	28	—	0.5	do	Blending, Ill.	do	do	—	do	—	do	—	do	4	0	—	—	—	—	5.00
3.3	—	—	Seasoned 1yr. after Treatment	30	—	0.5	do	Barr, Colo.	do	Lyons Shore	Very Dry	do	—	Yes	—	do	4	0	—	—	—	—	5.00
	ZINC CREOSOTE - CARD																						
4.1	—	—	—	433	—	0.5 Zinc 2.0 Creo.	1909	Lucas East	C.B.+Q.	Chalybeate Gravel Sand Clay	—	90	—	Partly	—	1914	5	1	Split	—	—	—	5.00
4.2	—	—	—	276	—	do	1910	do	do	Gravel	—	90	—	All	—	do	4	0	—	—	—	—	5.00
4.3	—	—	—	238	—	do	1909	Lucas West	do	Chalybeate Gravel Sand Clay	—	90	—	Yes	—	do	5	0	—	—	—	24% Split	5.00
4.4	—	—	—	182	—	do	1910	do	do	Lyons Shore	—	90	—	do	—	do	4	0	—	—	—	3% Split	5.00
								TABLE 4 - CEDAR															
	UNTREATED																						
1.1	—	—	—	329,774	—	—	1856	Nebraska	C.B.+Q.	—	—	—	—	—	—	1910	4	17.5	—	—	—	Includes Pine and Tamarack	1.10
1.2	—	—	—	438,380	—	—	1901	Wyo. + Mont.	do	—	—	—	—	—	—	do	9	11.5	—	—	—	do do Fir	1.10
1.3	—	—	—	83,200	—	—	1900	Canada	G.T.	—	—	—	—	—	—	do	10	6.1	—	—	—	—	1.10
1.4	—	—	—	11,117	—	—	1878	West Mich.	C.R.+I.	—	—	—	—	—	—	1910	16	100	—	—	—	Includes Oak	1.10+1.15
1.5	—	—	—	377,440	—	—	1856	Ont. Canada	T.H.&	—	—	—	—	—	—	1908	6 to 7	27.6	—	—	—	do Hemlock and Tamarack	1.10
1.6	—	—	—	119,680	—	—	1871-80	Wis	Northern	—	—	—	—	—	—	1910	10 to 11	36.9	—	—	—	Includes Hemlock Tamarack Spruce Jack Pine	1.10
1.7	7'8"×8'	—	—	1433	—	—	1906	Mohawk	G.N.	Gravel	Good	90 to 95	5% to 5%	None	—	1914	10	100	Flat	—	—	Includes Tamarack	4.00
1.8	4	4"	—	965	—	—	do	do	do	do	do	do	do	do	—	do	10	100	do	—	—	do do	4.00
1.9	6'2"×8'	4"	—	1288	—	—	1908	Wisconsin	C.M.+St.P.	Cinder	—	—	—	—	—	do	10	100	do	—	—	—	6.10

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2.1	—	—	—	300	—	—	1898	Bayou Grand, N.A.	C.B.&Q.	—	—	—	—	—	—	1910	15	100	—	Dead	—	1/3 composed Loss — Lost trees removed or little included Timber in bank poor condition as are Some Splends for balance Some Was Shot in service	15.00
2.2	—	—	—	—	—	—	1899	Indian and Pecan	do	—	—	—	—	—	—	do	—	100	—	—	—	15.00
	CREOSOTE - FULL CELL																					
2.3	—	—	—	15	—	—	1910	Hanover, Ill.	C.B.&Q.	Sparrington Gravel	—	90	—	All	—	1914	4	0	—	—	—	5.00
2.4	—	—	—	19	—	—	do	Standley, Ill.	do	do	—	do	—	do	—	do	4	4	—	—	—	5.00
2.5	—	—	—	29	—	—	do	Starr, Colo.	do	Lyons Stone	Very Dry	do	—	Yes	—	do	4	4	—	—	—	5.00
	OIL - CRUDE																					
3.1	—	—	—	8	—	—	1911	Hebron, Ill.	do	Gravel	—	95	—	Partly	—	1912	1	0	—	—	—	5.00
	UNTREATED																					
4.1	—	—	—	114	—	—	1909	Lines East	do	Ogden Gravel Bank Run	—	75-85	—	Partly	—	1914	5	34.2	Not	—	—	5.00
4.2	—	—	—	85	—	—	1910	do	do	Gravel	—	90	—	All	—	do	4	44	do	—	—	5.00
4.3	—	—	—	60	—	—	1909	Lines West	do	Ogden Gravel Bank Run	—	75-85	—	Yes	—	do	5	28.5	do	—	—	5.00
4.4	—	—	—	89	—	—	1910	do	do	Lyons Stone	—	90	—	do	—	do	4	5	do	—	—	5.00
4.5	7'9"x9'	—	—	6875	—	—	do	La Grange and Texas	C.M.&St.P.	Gravel	—	80	Screw	Chint. Formosa	—	do	4.5	0	Dead	—	—	7.00
4.6	7'6"x9'	—	—	500	—	—	1905	Grey Eagle to Lost Lyons	do	do	—	—	—	Absolute	—	do	9	31.8	—	—	Rest not due to wagon	7.00
4.7	do	—	—	500	—	—	do	do	do	do	—	—	—	None	—	do	9	31.8	—	—	31.6% do	7.00
4.24	7'9"x8'	—	—	2890	—	—	1909	do	do	do	—	80	Screw	Chint	—	do	5	0	Dead	—	May need renewals next year	7.00
4.25	do	—	—	3637	—	—	do	do	do	do	—	do	do	do	—	do	5	0	do	—	do	7.00
① 4.26	—	Hewn	—	282	—	—	1895	Mellen Cutoff	do	Dirt	—	—	—	Yes	—	do	19	36.5	—	—	Tasha Cypress	7.00
① 4.27	—	do	—	368	—	—	do	do	do	do	—	—	—	None	—	do	19	92.0	—	—	do do	7.00
② 4.28	—	do	—	44	—	—	do	do	do	Rock	—	—	—	Yes	—	do	19	100	—	—	Hermanster do	7.00
② 4.29	—	do	—	75	—	—	do	do	do	Earth	—	—	—	None	—	do	19	57.6	—	—	do do	7.00
③ 4.30	—	Sawed	—	641	—	—	do	do	do	Rock	—	—	—	Yes	—	do	19	100	—	—	Calcasieu do	7.00
③ 4.31	—	do	—	394	—	—	do	do	do	Earth	—	—	—	do	—	do	19	91.4	—	—	do do	7.00
③ 4.32	—	do	—	654	—	—	do	do	do	do	—	—	—	None	—	do	19	75.7	—	—	do do	7.00
4.33	—	—	Not seasoned	274	—	—	1909	Lula, Miss.	I.C.	River Gravel	—	75	—	4 Partly Others	—	do	—	—	—	—	Damaged by dirt/gravel 40" Timber ample bars.	12.00
4.34	—	—	do	274	—	—	do	do	do	do	—	do	—	do	—	do	—	—	—	—	do	12.00
4.35	—	—	do	274	—	—	1910	Grenada, Miss.	do	Dirt	—	do	—	Absolute Preference	—	1913	—	0	—	Some Dead	Weber Joints	12.00
4.36	—	—	—	242328	—	—	1908-9	Missouri	C.B.&Q.	—	—	—	—	—	—	1910	6-7	18	—	—	Includes White Oak	1.10
4.37	—	—	—	175500	—	—	1907	Louisiana	C.R.I.&P.	—	—	—	—	—	—	do	3	19	—	—	Includes White Oak, Pine & Gum	do
4.38	—	—	—	256160	—	—	1905	Arkansas	M.H.&L.	—	—	—	—	—	—	do	5	62	—	—	Includes White Oak & Red Oak	do
4.39	—	—	—	274	—	—	1910	Grenada, Miss.	I.C.	Dirt	—	95	—	4 Partly Others	—	1913	3	0	—	Some Dead	Weber Joints	12.00
	ZINC CHLORIDE - BURNETT																					
5.1	—	—	—	15	—	0.5	1910	Hanover, Ill.	C.B.&Q.	Sparrington Gravel	—	90	—	All	—	1914	4	0	—	—	—	5.00
5.2	—	—	—	10	—	do	do	Standley, Ill.	do	do	—	do	—	do	—	do	4	0	—	—	—	5.00
5.3	—	—	Sawed 1/2 other Trimmed	50	—	do	do	Starr, Colo.	do	Lyons Stone	Very Dry	do	—	Yes	—	do	4	0	—	—	—	5.00
	ZINC CREOSOTE - CARD																					
6.1	—	—	—	394	—	0.5 Zinc 2.0 Creo.	1909	Lines East	C.B.&Q.	Ogden Gravel Bank Run	—	75-85	—	Partly	—	1914	5	0	—	—	—	5.00
6.2	—	—	—	24	—	do	1910	do	do	Gravel	—	90	—	All	—	do	4	0	—	—	—	5.00
6.3	—	—	—	200	—	do	1909	Lines West	do	Ogden Gravel Bank Run	—	75-85	—	Yes	—	do	5	0	—	—	—	5.00
6.4	—	—	—	47	—	do	1910	do	do	Lyons Stone	—	90	—	do	—	do	4	0	—	—	—	5.00
										CYPRESS - RED												
	UNTREATED																					
7.1	—	—	—	1200	—	—	1895	Louisiana	I.C.	—	—	—	—	—	—	1909	14	4	—	—	—	12.20

① Average 1½ (Estimated by Forest Service) Per Index Nos. 4.26 and 4.27 combined was 13.97 Years.
② do do do 4.28 and 4.29 do do 13.95 do
③ do do do 4.30, 4.31 and 4.32 do do 15.67 do

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
										CYPRESS - YELLOW													
	UNTREATED																						
B.1	—	—	—	1679	—	—	1906	Memphis	I.C.	—	—	—	—	—	—	1909	3	35	—	—	—	—	12.20
B.2	7×9	—	—	43000	—	—	1902	do	do	—	—	—	—	—	—	do	7	40	—	—	—	—	do
B.3	do	—	—	19200	—	—	1900	do	do	—	—	—	—	—	—	do	9	60	—	—	—	—	do
B.4	do	—	—	67800	—	—	1899	do	do	—	—	—	—	—	—	do	10	60	—	—	—	—	do
B.5	6×8	—	—	34000	—	—	1901	do	do	—	—	—	—	—	—	do	8	60	—	—	—	—	do
B.6	7×9	—	—	25600	—	—	Other 1902	Vicksburg	do	—	—	—	—	—	—	do	Burr 7	90	—	—	—	—	do
B.7	do	—	—	25600	—	—	do	do	do	—	—	—	—	—	—	do	do	100	—	—	—	—	do
										TABLE 8 ELM - WHITE													
	CREOSOTE FULL CELL																						
1.1	—	—	—	106	—	12.97	1909	Lines East	C.B.&Q.	Cinders, Gravel Burnt Clay	—	75-85 lbs	—	Partly	—	1914	5	2.8	Broken	—	—	—	5.00
1.2	—	—	—	99	—	do	1910	do	do	Gravel	—	90	—	All	—	do	4	0	—	—	—	—	do
1.3	—	—	—	58	—	do	1909	Lines West	do	Cinders, Gravel Burnt Clay	—	75-85 lbs	—	Yes	—	do	5	0	—	—	—	—	do
1.4	—	—	—	60	—	do	1910	do	do	Lyons Stone	—	90	—	do	—	do	4	0	—	—	—	—	do
	CRUDE OIL																						
2.1	—	—	—	2	—	—	1911	Bodcaw, Ark.	do	Gravel	—	75	—	Except Side Joints	—	do	3	0	—	—	—	—	do
	UNTREATED																						
3.1	—	—	—	89	—	—	1909	Lines East	do	Cinders, Gravel Burnt Clay	—	75-85 lbs	—	Partly	—	do	5	35.2	Most	—	—	—	do
3.2	—	—	—	30	—	—	1908	do	do	Gravel	—	90	—	In Curves	—	do	6	100	do	—	—	76% Sound - 20% Broken - 4% Burned	do
3.3	—	—	—	25	—	—	1910	do	do	Sheridan Gravel	—	90	—	All	—	do	4	32.0	do	—	—	—	do
3.4	—	—	—	40	—	—	1909	Lines West	do	Cinders, Gravel Burnt Clay	—	75-85 lbs	—	Yes	—	do	5	72.0	do	—	—	—	do
3.5	—	—	—	30	—	—	1910	do	do	Lyons Stone	Very Dry	90	—	do	—	do	4	3.0	do	—	—	—	do
	ZINC CHLORIDE - BURNETT																						
4.1	—	—	—	77	—	0.5	1909	Lines East	do	Cinders, Gravel Burnt Clay	—	75-85 lbs	—	Partly	—	do	5	2.8	—	—	—	—	do
4.2	—	—	—	146	—	do	1910	do	do	Sheridan Gravel	—	90	—	All	—	do	4	—	—	—	—	2 Split - 1 Broken - 1 Shaky	do
4.3	—	—	—	43	—	do	1909	Lines West	do	Cinders, Gravel Burnt Clay	—	75-85 lbs	—	Yes	—	do	5	0	—	—	—	—	do
4.4	—	—	—	30	—	do	1910	do	do	Lyons Stone	Very Dry	90	—	do	—	do	4	0	—	—	—	—	do
	ZINC CREOSOTE - CARD																						
5.1	—	—	—	444	—	0.5 Zinc 0.5 Creo.	1909	Lines East	do	Cinders, Gravel Burnt Clay	—	75-85 lbs	—	Partly	—	do	5	—	—	—	—	—	do
5.2	—	—	—	195	—	do	1908	do	do	Gravel	—	90	—	In Curves	—	do	6	9	—	—	—	—	do
5.3	—	—	—	149	—	do	1910	do	do	do	—	90	—	All	—	do	4	—	—	—	—	—	do
5.4	—	—	—	165	—	do	do	do	do	Piles driven in 1913	—	66	—	None	—	do	4	0.8	—	—	—	—	do
5.5	—	—	—	244	—	do	1909	Lines West	do	Cinders, Gravel, Clay, Stone	—	75-85 lbs	—	Yes	—	do	5	2.8	—	—	—	—	do
5.6	—	—	—	121	—	do	1910	do	do	Lyons Stone	Very Dry	90	—	do	—	do	4	—	—	—	—	—	do
										ELM													
	CRESOL - CALCIUM - NO STEAMING																						
6.1	—	—	Seasoned	9	—	0.5	1910	Greenville, Miss.	I.C.	Dirt	—	75	—	1 Toothed Spikes	—	1913	3	0	—	Sheer Portion Decay	—	Sheer decay where in contact with earth - Water Joints.	12.00
										TABLE 9 - FIR-RED													
	CREOSOTE - FULL CELL																						
1.1	7'-8"×8'	—	—	224	144 Gal	2.75	1910	Butte, Mont.	Anaconda Mine Co.	Rock	Poor	90	Single	Cable Spk	Heavy	1911	1	—	—	—	—	—	24.00
	ZINC CHLORIDE - BURNETT - ZINC CREOSOTE - ALLARDYCE - CREOSOTE - RED PINE																						
2.1	—	—	—	61	—	—	1906	Sheridan, Wyo	C.B.&Q.	Sandstone Gravel	—	85	—	Stulls	—	1914	8	19.7	Decay	—	—	Incheeks Lodgepole Pine	5.60
										FIR													
	COPPER SULPHATE BOILED																						
8.1	—	—	—	36640	—	—	1898	Butte, Montana	R.M.R.R.	—	—	—	—	—	—	1946	16	66.2	—	—	14	—	39.70
	COPPER SULPHATE - STEEPED																						5.40
	—	—	—	[illegible]	—	—	1851	do	[illegible]	—	—	—	—	—	—	[illegible]	[illegible]	68.2	—	—	14.2	—	do

FIR. DOUGLAS

5.1	—	—	—	44,000	—	—	1907-8	Germany	N. Ry. Co.	—	—	—	—	—	—	1886	15	16.9	—	—	15	—		5.28
6.1	CREOSOTE	—	—	—	—	—	—	do	G.V.R.R.	—	—	—	—	—	—	—	—	—	—	—	14-15	—		5.28
7.1	SALINE - BARBERTON, MISSOURI	—	—	45897	—	—	1908	—	C.R.I.& P.	—	—	—	—	—	—	1908	8	10.0	—	—	—	Good Ties		1.00
8.1	PRESERVATIVE NOT KNOWN	—	—	315900	—	—	1906	Wyoming	do	—	—	—	—	—	—	1910	4	6.25	—	—	—	Inchoate Plant		4.10
	UNTREATED (USED CEDAR TABLE 1-AR)																							
9.1	—	—	—	882 487	—	—	—	Germany	Sic Ry's	—	—	—	—	—	—	1889	—	—	—	—	31.2	—		9.26
9.2	—	—	—	79800	—	—	1895-7	do	—	—	—	—	—	—	—	do	11	12.9	—	—	20	—		28.90
9.3	—	—	—	146800	—	—	1899	do	Schlesing	—	—	—	—	—	—	do	15	20.7	—	—	26	—		do
9.4	—	—	—	98585	—	—	1895	do	I. Grunds	—	—	—	—	—	—	do	12	17.0	—	—	23.9	—		do
9.5	—	—	—	69291	—	—	1894	do	T. Keller	—	—	—	—	—	—	do	13	22.8	—	—	32.4	—		do
	VARIOUS PROCESSES																							
10.1	6½" sapwood	—	—	69 841	—	—	—	do	—	—	—	—	—	—	—	—	—	—	—	—	14	15 Railroads - Inchoate Plant		do
	ZINC CHLORIDE - BURNETT																							
11.1	—	—	—	12,000,000	—	0.37	1895	—	S.R.	—	—	—	—	—	—	1908	13	—	—	Shade Tight	11-12	Inchoate Plant		1.00
11.2	—	—	—	4,888,668	—	0.35-0.5	1899	—	C.B.&Q.	—	—	—	—	—	—	do	9	—	—	—	11-12	do	Refuse exposed under Earth	do
11.3	—	—	—	—	—	0.25	1902	—	U.R.	—	—	—	—	—	—	do	6	—	—	—	11-13	do		do
11.4	—	—	—	—	—	0.78	1904	—	G.N.	—	—	—	—	—	—	do	4	0	—	—	—	do		do
11.5	—	—	—	161 515	—	—	1894-6	Germany	Mo. Pac. Ry.	—	—	—	—	—	—	1899	24	44.3	—	—	32.8	Life extended 2.2 years		12.76 1.70
	ZINC CHLORIDE																							
12.1	—	—	—	—	—	—	—	Switzerland	S.N.-G.B.	—	—	—	—	—	—	—	—	—	—	—	10-14	do 7-8		3.00
	ZINC TANNIN - WELLHOUSE																							
13.1	7'0"x8'	—	—	—	—	0.78	1886	—	U.R.	—	—	—	Cut	—	—	—	—	—	—	—	6-8	Split in Spiking		do
	CREOSOTE - FULL CELL																							
14.1	7'0"x8'	Sap	Seasoned	173	—	6.2	1906	Hayward, Mich	N.P.	Gravel	Gravel	85	Cut	Flat	Heavy	1915	2.3	21.3	—	Poor	—	—		25.00
14.2	do	do	do	46	—	do	do	do	do	do	do	do	Butt Sawn	do	do	do	do	15.3	—	—	—	—		do
14.3	do	do	do	100	—	do	do	do	do	do	do	do	Sawn	Sellers	do	do	do	6.0	—	—	—	Mail Cart		do
14.4	do	do	do	71	—	do	do	do	do	do	do	do	Cut	Hewn	do	do	do	7.0	—	—	—	Forward Over		do
14.5	do	do	do	52	—	do	do	do	do	do	do	do	do	Sellers	do	do	do	0	—	—	—	Sawn spoke pocket over Canal		do
14.6	—	—	—	1,287,915	—	8-10	do	—	C.B.&Q.	—	—	—	—	—	—	1908	2	0	—	—	—	—		1.00
14.7	—	—	Mid Seasoned	74	—	7.456	1905	Cloquet, Minn	C.B.&Q.	—	—	—	—	Sellers	—	1914	8.5	14	—	—	—	Treated 2 bpo. other Agency		5.10
	CREOSOTE - OPEN TANK																							
14.1	—	—	Mid Seasoned	52	—	5.99	do	do	do	—	—	—	—	do	—	do	8.5	—	—	—	—	do		do
	CREOSOTE - DIPPING																							
14.2	—	—	Mid Seasoned	40	—	5.995	do	do	do	—	—	—	—	do	—	do	8.5	0	—	—	—	do		do
	UNTREATED																							
15.1	7'0"x8'	Hewn	Green	95	—	—	1907	Flavia, Mont	N.P.	Gravel	Excellent	12x85	Sawn 3pc.10 2pc.12 3pc.14	Sta Hewn	Heavy	1915	8.3	19.0	—	—	26.3	Mail changed 3 April to 19.10 Tattoo - Vancouver Treated 20 L Sellers L		25.00
15.2	do	do	do	94	—	—	do	do	do	do	do	85	Cut	Adequate	do	do	do	100.0	—	—	27.58	—		do
16.1	do	do	do	108	—	—	do	do	do	do	do	do	Butt Sawn	Sellers	do	do	do	97.2	—	—	27.78	—		do
16.2	do	Sawn	do	264	—	—	1906	Hayward, Mich	do	do	Good	do	Cut	do	do	do	do	65.0	—	—	—	—		do
16.3	do	do	do	46	—	—	do	do	do	do	do	do	Sawn	do	do	do	do	46.8	—	—	—	—		do
16.4	do	do	do	47	—	—	do	do	do	do	do	do	Butt Sawn	do	do	do	do	86.1	—	—	—	—		do
16.5	do	do	do	100	—	—	do	do	do	do	do	do	Cut	do	do	do	do	98.0	—	Shade Tight	—	—		do
16.6	do	do	do	100	—	—	do	do	do	do	do	do	Cut	Hewn	do	do	do	98.0	—	do	—	—		do
16.7	do	Hewn	do	91	—	—	1909	Flavia, Mont	do	do	Excellent	do	Cut	Sellers	do	do	do	100.0	—	—	27.56	—		do
16.8	do	do	do	90	—	—	do	do	do	do	do	do	Sawn	do	do	do	do	100.0	—	—	27.71	—		do

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
16.9	7'-9"x 8"	Howe	Seasoned	32	—	—	1907	Plains Mont	N.P.	Gravel	Excellent	72	Sap 2" Cut 2"	Ord Wood Adequate	Heavy	1905	8.3	19.0	Creosoted	Fair	7.63	—	25.00
16.10	〃	〃	〃	90	—	—	〃	〃	〃	〃	〃	85	Cut	Subsoil	〃	〃	〃	19.4	—	—	7.98	—	〃
16.11	〃	〃	〃	90	—	—	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	19.9	—	—	7.56	—	〃
16.12	〃	〃	〃	90	—	—	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	19.8	—	—	7.56	—	〃
16.13	〃	〃	〃	180	—	—	〃	〃	〃	〃	〃	〃	Sap 2" Cut 2"	〃	〃	〃	〃	19.9	—	Good Treated	7.78	—	〃
16.14	〃	〃	〃	89	—	—	〃	〃	〃	〃	〃	〃	Cut	N.P. 21	〃	〃	〃	19.5	—	Good Treated	7.56	—	〃
16.15	〃	Stout	〃	100	—	—	1906	Hayward, Wash.	〃	〃	Good	〃	Cut Sap 2" Sound	Flat	〃	〃	〃	19.0	—	Good Treated	—	—	〃
16.16	〃	〃	〃	98	—	—	〃	〃	〃	〃	〃	〃	Sap 2"	None	〃	〃	〃	19.0	—	—	—	—	〃
16.17	〃	〃	〃	98	—	—	〃	〃	〃	〃	〃	〃	〃	Subsoil	〃	〃	〃	69.8	—	—	—	—	〃
16.18	〃	〃	〃	91	—	—	〃	〃	〃	〃	〃	〃	Sap 2" Cut 2"	〃	〃	〃	〃	64.8	—	Good Treated	—	—	〃
16.19	〃	〃	〃	350	—	—	〃	〃	〃	〃	〃	〃	Cut	〃	〃	〃	〃	72.4	—	—	—	—	〃
16.20	〃	〃	〃	99	—	—	〃	〃	〃	〃	〃	〃	〃	None	〃	〃	〃	19.0	—	Some Decay	—	—	〃
16.21	〃	〃	〃	284	—	—	〃	〃	〃	〃	〃	〃	〃	Flat	〃	〃	〃	71.8	—	—	—	—	〃
16.22	6'-6"x 8'	Heart	Improperly Seasoned 1yr.	64	—	—	1910	Calumet Mich	Ell. Ry.	〃	〃	—	—	None	Light	1914	4	0	—	—	—	Timber cut in Summer months shows signs of dry rot	41.00
16.23	〃	〃	〃	100	—	—	1905	Hayward Wash	N.P.	〃	〃	85	Sap 2" Cut 2"	Flat	Heavy	〃	8.3	0	—	—	—	Some what decayed	35.00
16.24	—	—	Well Seasoned	89	—	—	1905	Elsberry Mo	C.B.&Q.	—	—	—	—	—	—	1914	8.5	44.9	—	—	—	Treated 2½ yrs after laying	5.10
16.25	7'-8"x 8'	Stout	—	137	—	—	1911	Allegheny Penn	C.R.&I.P.	Cinder	Good	65	Cut	None	Average	1915	4	0	—	—	—	—	6.10
16.26	〃	〃	—	500	—	—	1912	Custer S.D.	〃	〃	Fair	90	〃	Subsoil	〃	〃	5	0	—	—	—	—	〃
	ZINC CHLORIDE - BURNETT																						
17.1	7"x 9"x 8'	Stout	Partly Seasoned	219	—	0.843	1895	Kansas Mexico	S.P.	18 plows 10" Gravel 12" Earth	—	52-76	Cut 2"	Sub Grade Adequate	Heavy	1914	15	100	All Creosoted	—	11.34	Avg. life estimated by Road Service	32.00
17.2	〃	〃	〃	1043	—	〃	1896	〃	〃	〃	〃	〃	〃	〃	〃	〃	13	100	〃	—	12.97	〃	〃
17.3	〃	〃	〃	1941	—	〃	1897	〃	〃	〃	〃	〃	〃	〃	〃	〃	13	100	〃	—	12.74	〃	〃
17.4	〃	〃	〃	20536	—	〃	1898	〃	〃	〃	〃	〃	〃	〃	〃	〃	14	100	〃	—	11.21	〃	〃
17.5	〃	〃	〃	12951	—	〃	1899	〃	〃	〃	〃	〃	〃	〃	〃	〃	14	100	〃	—	10.46	〃	〃
17.6	〃	〃	〃	26146	—	〃	1900	〃	〃	〃	〃	〃	〃	〃	〃	〃	13	100	〃	—	9.21	〃	〃
17.7	〃	〃	〃	43681	—	〃	1901	〃	〃	〃	〃	〃	〃	〃	〃	〃	13	88.57	〃	—	10.15	〃	〃
17.8	〃	〃	〃	32204	—	〃	1902	〃	〃	〃	〃	〃	〃	〃	〃	〃	12	99.3	〃	—	9.45	〃	〃
17.9	〃	〃	〃	44056	—	〃	1903	〃	〃	〃	〃	〃	〃	〃	〃	〃	11	99.6	〃	—	9.72	〃	〃
17.10	〃	〃	〃	42541	—	〃	1904	〃	〃	〃	〃	〃	〃	〃	〃	〃	10	58.8	〃	—	9.46	〃	〃
17.11	〃	〃	〃	53983	—	〃	1905	〃	〃	〃	〃	〃	〃	〃	〃	〃	9	65.7	〃	—	9.46	〃	〃
17.12	〃	〃	〃	48478	—	〃	1906	〃	〃	〃	〃	〃	〃	〃	〃	〃	0	42.9	〃	—	—	—	〃
17.13	〃	〃	〃	28673	—	〃	1907	〃	〃	〃	〃	〃	〃	〃	〃	〃	7	57.0	〃	—	—	—	〃
17.14	〃	〃	〃	46689	—	〃	1908	〃	〃	〃	〃	〃	〃	〃	〃	〃	6	28.4	〃	—	—	—	〃
17.15	〃	〃	〃	82146	—	〃	1909	〃	〃	〃	〃	〃	〃	〃	〃	〃	5	7.4	〃	—	—	—	〃
17.16	〃	〃	〃	134774	—	〃	1910	〃	〃	〃	〃	〃	〃	〃	〃	〃	4	0.9	〃	—	—	—	〃
17.17	〃	〃	〃	141449	—	〃	1911	〃	〃	〃	〃	〃	〃	〃	〃	〃	3	0	〃	—	—	—	〃
17.18	〃	〃	〃	142111	—	〃	1912	〃	〃	〃	〃	〃	〃	〃	〃	〃	2	—	〃	—	—	—	〃
17.19	〃	〃	〃	134293	—	〃	1913	〃	〃	〃	〃	〃	〃	〃	〃	〃	1	—	〃	—	—	—	〃
17.20	〃	〃	〃	112155	—	〃	1914	〃	〃	〃	—	〃	〃	〃	〃	〃	0	—	〃	—	—	—	〃
17.21	〃	〃	〃	90	—	0.786	1907	Flying Albert	N.P.	Gravel	Excellent	85	Sap 2" Cut 2"	Subsoil	〃	1915	8.3	11	—	—	—	None will renew when the contracted	26.00
17.22	〃	〃	〃	107	—	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	27	—	—	—	No decay in 1915	〃
17.23	—	—	Well Seasoned	91	—	0.862	1905	Elsberry Mo	C.B.&Q.	—	—	—	—	—	〃	1914	8.5	52	—	—	—	Treated 2½ yrs after laying	5.10
	ZINC CHLORIDE - BOILER																						
18.1	—	—	Seasoned 2 mos.	61	—	—	1900	Sturvilion Wy.	〃	—	Poor	—	—	—	Heavy	1912	8	30	Creosoted	—	—	All to go out in 1918	5.00
	ZINC CREOSOTE - ALLARDICE																						
19.1	—	—	Well Seasoned	41	—	647 Creo. 0.53 Zinc	1905	Elsberry Mo	〃	—	—	—	—	Subsoil	—	1914	8.5	48	—	—	—	Treated 2½ yrs after laying	5.10
	FIR - GRAND																						
	ZINC CHLORIDE - BOILER																						
19.2	6'-6"x 8'	Hewn	Improperly Seasoned 1yr	0	—	—	1910	Oakwood, Wash	R.R.&N.R.	—	Good	—	—	None	Light	1914	4	0	Good	—	—	A perfectly split	41.00
	FIR - OREGON																						
	CARBOLINEUM																						

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20.1																							
	UNTREATED																						
20.1	—	Sawed	Sandhill Ala.	1906	—	—	do	do	do	do	do	do	—	—	do	1913	4	0	—	—	—	Hills above surface decay	do
20.2	—	do	not Seasoned	1897	—	—	do	do	do	do	do	do	—	—	do	do	4	0	—	Poor	—		do
	ZINC CHLORIDE - BURNETT																						
21.1	—	Sawed	Sandhill Ala.	977	—	0.35	1909	do	do	do	do	do	—	—	do	1916	5	0.4	—	—	—		do
21.2	—	do	Not Seasoned	975	—	do	do	do	do	do	do	do	—	—	do	do	5	0.4	—	—	—		do
21.3	—	do	Sandhill-Conn.	1969	—	do	do	do	do	do	do	do	—	—	do	do	5	0.4	—	—	—		do
21.4	—	—	—	45 Mi.	—	—	1906	Nevada	G.Sh. Line	—	—	—	—	Yellowpine	—	do	11	55.0	—	Good	7 to 8	Yellowpine Pitch pine shorter life about 9 of 11 durable	32.00
21.5	—	—	—	36 Mi.	—	—	do	do	do	—	—	—	—	do	—	do	11	33.0	—	—	do	do	do
21.6	—	—	—	18 Mi.	—	—	do	Utah	do	—	—	—	—	—	—	do	11	64.0	—	—	6 to 10	Soil around & creosoted Zinc Chloride	do
21.7	—	—	—	28 Mi.	—	—	do	Sugar, Utah	do	—	—	—	—	—	—	do	N	72.0	—	—	—	Early failure of poles 1 to 3 years old	do
21.8	—	—	—	8 Mi.	—	—	do	Lay, Utah	do	—	—	—	—	—	—	do	11	110.0	—	—	7	Maximum life 12 years	do
21.9	—	—	—	46 Mi.	—	—	do	Hayes, Utah	do	—	—	—	—	—	—	do	N	—	—	Good	—	Show most rot where gravel holes used	do
21.10	—	—	—	3 Mi.	—	—	do	Ogden, Utah	do	—	—	—	—	Yellowpine	—	do	11	33.0	—	—	6	The remainder removed in 1914	do
21.11	—	—	—	300 000 feet gross	—	0.25	1905-10	Main Line	do	—	—	—	—	—	—	—	—	—	—	—	71.9	17% of failures due to decay	do
	ZINC CHLORIDE																						
22.1	—	—	—	3914	—	—	1913	Bingham Jct. Utah	C.B.&Q.	Slag	—	Wood of Ties	—	Partly	—	1918	9	54.	All Ground	—	—	Triangular ties	6.00
	SALT TREATED (GREAT SALT LAKE UTAH) 22.5% SOLIDS																						
22.1	—	—	—	15000	—	—	1899	Great Salt Lake	O.S.L.	—	—	—	—	—	—	1904	5	—	—	—	—	Show no advantage over untreated ties	32.00

TABLE 10 GUM-RED

	CREOSOTE - FULL CELL																						
11	—	—	—	85	—	9.83	1909	Lines East	C.B.&Q.	Cinders, Gravel, Burnt Clay	—	Yellow Pine	—	Partly	—	1914	5	0	—	—	—		5.00
12	—	—	—	48	—	do	do	Lines West	do	do	—	do	—	Yes	—	do	5	0	—	—	—		5.00
13	6"-8"-8'	Sawed	—	88	53.31	12.52	1905	Big Horn, Nr. San Louis, Mon.	G.N.W.S.A.	—	—	Screw	—	—	—	do	9	42.8	—	—	—	Started to fail 1908	7.00
14	do	do	—	37	do	do	do	do	do	—	—	—	—	Glandon	—	do	9	33.8	—	—	—	do 1912	do
15	do	do	—	45	do	do	do	do	do	—	—	—	—	None	—	do	9	33.3	—	—	—	do 1912	do
16	do	do	—	86	38.45	14.45	do	do	do	—	—	Screw	—	—	—	do	9	9.7	—	—	—	No Steaming	do
17	do	do	—	89	do	do	do	do	do	—	—	—	—	Glandon	—	do	9	17.2	—	—	—	do	do
18	do	do	—	53	do	do	do	do	do	—	—	—	—	None	—	do	9	21.2	—	—	—	do	do
	CREOSOTE - GIUSSANI																						
2.1	—	—	—	43	—	—	do	Rocks Mo.	St.L.V.S.R.	—	—	—	—	—	—	do	9	12.6	—	—	—	Includes Red Oak	38.00
2.2	—	—	—	18	—	—	do	do	do	—	—	—	—	—	—	do	9	27.7	—	—	—	do Incomplete record	do
	CREOSOTE - NO STEAMING																					do	
3.1	—	—	—	83	—	—	do	do	do	—	—	—	—	—	—	do	9	3.6	—	—	—	do	do
	CREOSOTE - LIVE STEAM IN SUPERHEATED COILS																						
4.1	—	—	—	24	—	—	do	do	do	—	—	—	—	—	—	do	9	4.2	—	—	—	do	do
	CREOSOTE - BETHEL																						
5.1	—	—	—	78	—	—	do	do	do	—	—	—	—	—	—	do	9	4.3	—	—	—	do	do
	CREOSOTE - RUEPING																						
6.1	6"-8"-8'	Sawed Quartered	Seasoned Dyn.	74	9.53	—	1906	St. Clair, Mo.	do	Gravel	Good	Screw & Plug	Cut	None	Heavy	do	0	0	—	Good	—	Rail charged 1909	do
6.2	do	Faced Adzed Cut	do	247	9.00		do	do	do	do	do	do	do	do	do	do	8	0	—	do	—	do Includes Red Oak	do
6.3	—	—	—	40	—	—	1905	Pacific, Mo.	do	—	—	—	—	—	—	do	9	2.5	—	—	—		do
	PRESERVER - DIAMOND WOOD																						
7.1	7"-9"-8'	Hemn	—	500	0.25 Gal.	0.21 Gal	1907	Ft. Hancock, Tex.	G.H.W.S.A.	Slag	—	—	Cut	Glandon	—	do	7	0	—	Good	—		5.00 - 5.22

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Preservative	Process	Species	Weight lb.
Zinc Creosote	Card	Poplar	26
do	do	Sycamore	28
do	do	Tamarack	29
do	Giussani	Pine	23
do	Low Pressure	Oak, Red	20
do	Rutgers	Beech	12
do	Two Movement	Maple	15
Zinc & Copper Sulphate, Bonnie Chloride	Thilmany	Pine, White	25
Zinc Tannin	Wellhouse	Ash	1
do	do	Beech	2
do	do	Cedar	4
do	do	Cottonwood	6
do	do	Cottonwood, White	6
do	do	Fir	9
do	do	Gum	10
do	do	Gum, Sweet	10
do	do	Hemlock	12
do	do	Maple	15
do	do	Oak, Black	18
do	do	Oak, Red	20
do	do	Oak, Spanish	21
do	do	Oak, Turkey	21
do	do	Oak, White	22
do	do	Oak, Willow	22
do	do	Pine, Colorado	23
do	do	Pine, Loblolly	24
do	do	Pine, Longleaf	25
do	do	Pine, Mountain	25
do	do	Pine, Red Norway	25
do	do	Pine, Sap	29
do	do	Pine, Shortleaf	26
do	do	Pine, White	25
do	do	Tamarack	29
do	do	Various	30

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INDEX NUMBER	DIMENSIONS	FORM	PREPARATION	NUMBER OF PIECES IN TEST	INS. ABSORPTION lbs/ft³	INS. ABSORPTION lbs/sq ft	DATE PLACED	LOCALITY	COMPANY NAME	BALLAST	DRAINAGE	RAIL WEIGHT lbs/yd	SPIKES	TIE PLATES	TRAFFIC	DATE REMOVED	TIMES IN SERVICE	% REMOVED	CAUSE OF REMOVAL	CONDITION	AVG LIFE YEARS	REMARKS	PER CENT
TABLE 1 - ASH																							
CREOSOTE - FULL CELL																							
1.1	——	——	——	19	——	9.88	1910	Lines East	C.B.&Q.	Sheridan	——	90	——	A.H.	——	1918	4	0	——	——	——	——	5.00
1.2	——	——	——	1	——	9.62	1909	Lines West	do	Gravel, Clay and Cinders	——	85	——	Yoe	——	do	5	0	——	——	——	——	5.00
1.3	——	——	——	15	——	9.62	1910	do	do	Lyons Stone	Very Dry	90	——	do	——	do	4	0	——	——	——	——	5.00
CREOSOTE - RAMPING																							
① 2.1	——	——	Well Seasoned	274	——	5.00	1909	Fulton, Ky	I.C.	Gravel	——	90	——	Economy	——	1913	4	0	——	Good	——	Continuous angle bars	12.00
② 2.2	——	——	do	274	——	5.00	1910	Greenville, Miss	do	Dirt	——	75	——	do	——	do	3	0	——	do	——	Weber Joints	12.00
UNTREATED																							
3.1	——	——	——	58	——	——	1909	Lines East	C.B.&Q.	Crushed Gravel Gravel Clay	——	75-85 90	——	Yoe	——	1910	3	76	Rail	——	——	——	3.00
3.2	——	——	——	14	——	——	1910	do	do	Gravel	——	90	——	A.H.	——	do	4	13.8	do	——	——	——	3.00
3.3	——	——	——	30	——	——	1909	Lines West	do	Crushed Gravel Gravel & Cinders	——	75-85 90	——	Yoe	——	do	5	76.7	do	——	——	——	5.00
3.4				15			1910	do	do	Lyons Stone		90		do		do	4	80.0	do			50% show checking	5.00
ZINC CHLORIDE																							
4.1	——	——	——	16	——	0.5	1910	Lines East	C.B.&Q.	Gravel	——	90	——	A.H.	——	1914	4	0	——	——	——	——	5.00
4.2	——	——	Seasoned - Kyan	15	——	0.5	1910	Lines West	do	Lyons Stone	——	90	——	Yoe	——	do	4	0	——	——	——	——	5.00
③ 4.3	——	——	Seasoned	275	——	0.5	1909	Hannibal, Ill.	I.C.	Old Road	——	90	——	4 Hayfield Economy 2 Yoe	——	1913	4	0	——	Good	——	Continuous angle bars	12.00
④ 4.4	——	——	do	274	——	0.5	1910	Bloomington, Ill.	do	Old Gravel	——	75	——	3 Hayfield Economy 2 Yoe	——	do	3	0	——	do	——	Weber Joints	12.00
⑤ 4.5	——	——	do	274	——	0.5	1909	Fulton, Ky	do	do	——	90	——	3 Hayfield Economy 2 Yoe	——	do	4	0	——	do	——	Continuous angle bars	12.00
⑥ 4.6	——	——	do	274	——	0.5	1910	Lula, Miss.	do	New Gravel	——	75	——	3 Hayfield 2 Yoe	——	do	3	0	——	——	——	40° angle bars	12.00
⑦ 4.7	——	——	do	274	——	0.5	1910	Greenville, Miss.	do	Dirt	——	75	——	3 Hayfield Economy	——	do	3	1.0	Broken	Good	——	Weber Joints 1½% decayed	12.00
ZINC CREOSOTE - CARD																							
5.1	——	——	——	148	——	0.5 Zinc 2.0 Creosote	1909	Lines East	C.B.&Q.	Crushed Gravel Gravel Clay	——	75-85 90	——	Portly	——	1914	5	0	——	——	——	——	5.00
5.2	——	——	——	125	——	do	1910	do	do	Gravel	——	90	——	do	——	do	4	0	——	——	——	——	5.00
5.3	——	——	——	88	——	do	1909	Lines West	do	Crushed Gravel Gravel Clay	——	75-85 90	——	Yoe	——	do	5	0	——	——	——	——	5.00
5.4	——	——	——	15	——	do	1910	do	do	Lyons Stone	——	do	——	do	——	do	4	0	——	——	——	——	5.00
ZINC TANNIN - WELLHOUSE																							
⑧ 6.1	——	——	——	——	——	——	1886	Santa Fe, N.M.	U.R.	——	——	——	——	——	——	1915-8	9-12	100	——	——	——	Began to fail in 1893	2.00
TABLE 2 - BEECH																							
CREOSOTE																							
1.1	——	——	——	1000-2000	7.12 - 5.96	——	1885-6	Prussia	Imperial R.R.	——	Poor	——	——	——	——	1915-6	10	63	Decay	——	——	——	29.00
1.2	——	——	——	do	do	——	do	do	do	——	Good	——	——	——	——	do	10	0	——	——	——	——	do
1.3	6½"×10"×8'-10"	——	——	4000	——	——	——	Germany	do	——	——	——	——	——	——	——	——	——	——	——	——	——	do
1.4	do	——	——	——	6.6.0	——	——	do	Union Ry	——	——	——	——	——	——	1916	——	——	——	——	——	——	12.00
1.5	do	——	——	——	7.9.2	——	——	do	do	——	——	——	——	——	——	——	——	——	——	——	——	——	do
1.6	——	——	——	1440	——	——	1885	do	Calvo's Ribbon	——	——	——	——	——	——	1880	20	46.9	——	——	——	——	29.70
1.7	——	——	——	——	——	——	——	France	——	——	——	——	——	——	——	1915	——	——	——	——	——	——	10.10
1.8	——	——	——	——	——	6.8	1887	——	C.R.I.&P.	——	——	——	——	——	——	1908	1	——	——	——	——	——	1.00
1.9	——	——	——	——	——	——	——	Germany	Prussian R.R.	——	——	——	——	——	——	——	——	——	——	——	30	——	2.00
CREOSOTE - FULL CELL																							
2.1	—	—	—	206	—	11.12	1909	Lines East	C.B.&Q.	Crushed gravel Gravel Clay	—	75-85 90	—	Portly	—	1914	5	0	—	—	—	—	5.00
2.2	—	—	—	99	—	do	1910	do	do	Gravel	—	90	—	do	—	do	4	0	—	—	—	—	do
2.3	—	—	—	119	—	do	1909	Lines West	do	Crushed Gravel Gravel Clay and Cinders	—	75-85 90	—	Yoe	—	do	5	0	—	—	—	—	do
2.4	—	—	—	44	—	do	1910	do	do	Lyons Stone	—	90	—	do	—	do	4	0	—	—	—	—	do

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
2.5	7'-9"-18'-6	Seasoned	Seasoned	250	2.5 Gal	—	1905	Winder, Ala	B.L.Y.R.	Stone	do	101	C.C.	Same as Ballast	—	do	7	—	—	—	—	Includes Gum	Incl. in 2.4
2.6	do	—	Seasoned	255	—	—	1905	Bonifay Fla	B.L.Y.R.	Stone	do	101	do	do	—	do	7	—	—	—	—	Includes Birch + Maple	44.00
2.1	8.1'-18.2'-23.3'	—	Seasoned-6 mo	356850	39-66	—	—	France	Cockerell	—	—	Steel Rails	Log across	Regular	—	—	—	—	—	—	25-30	Water	8.20
	CREOSOTE - LOWRY																						
3.1	—	—	—	6288	2.5 Gal	—	1910	Buffalo, N.Y.	N.Y.C.	Stone + Gravel	—	80-100	Cut	1/2" Rebd	Heavy	1912	2	0	—	—	—	Triple Bo with flange through middle	14.00
3.2	—	—	—	7488	do	—	do	Erie, Pa.	do	Cinders	—	80	do	None	do	do	do	0	—	—	—	do	14.00
3.3	—	—	—	7984	do	—	do	Sandusky, N.Y.	do	Gravel	—	80-100	do	do	do	do	do	.0	—	—	—	do	14.00
3.4	—	—	—	5706	do	—	do	Norwalk Div.	do	Cinders	—	65	do	6% Rebd	—	do	do	0	—	—	—	Triple Bo with flange through middle	14.00
3.5	—	—	—	6000	do	—	do	Air Line Div.	do	Gravel	—	80	do	None	—	do	do	0	—	—	—	do	14.00
3.6	—	—	—	6000	do	—	do	Elkhart Div.	do	do	—	65	do	Yes	—	do	do	0	—	—	—	Triple Bo with flange through middle	14.00
3.7	6'-8"-9'	—	Seasoned	3000	2.75	—	1911	Clear Water,	L.S.M.C.	Stone	Good	80	—	None	Heavy	do	1	0	—	—	—	do	5.10
3.8	7'-9"-18'-6	—	Seasoned	812	5 Gal	—	1913	Bellevue, Md	D.L.Y.W.	do	do	101	Screws	D.L.Y.W.	—	1915	2	0	0	0	0	Includes Birch + Maple	44.00
3.9	—	do	do	158000	2.5 Gal	—	1908-11	Cut off	do	do	do	101-11	do	do	—	do	5'-6"	0	—	—	—	Includes Birch, Maple, Sap Pine, Gum Elm, No of Ash	do
4.1	—	—	—	5	—	—	1911	Bodine, Tex	C.B.+Q.	Gravel	—	75	—	Was on rail under joints	—	1912	—	0	—	—	—		5.00
5.1	CREOSOTE - WEEPING See ASH for No's 1-2.1																						
	—	—	Seasoned	274	—	5	1909	Lula, Miss.	I.C.	Gravel	—	75	—	Rail Bottom	—	1912	3	—	—	—	—	40" Tudor bars	12.00
5.2	—	—	—	248	—	—	1910	Bloomington, Ill.	I.C.	Old Gravel	—	75	—	do	—	1912	3	0	—	Good	—	Water angle bars	12.00
	LIQUID - J.M. LOWE'S																						
6.1	—	—	Seasoned	99	—	0.287	1910	Greenville, Miss.	I.C.	Dirt	—	75	—	Rail Bearing	—	1913	—	0	—	Fair	—	Many areas of surface decay where Tees are by Shim	18.00
	OIL - CRUDE																						
7.1	—	—	—	6	—	—	1911	Bodine, Ill	C.B.+Q.	Gravel	—	75	—	Was on rail under joints	—	1911	1	0	—	—	—		5.00
	SALTS (BARSCHALL - HASSELMANN)																						
8.1	—	—	—	99	—	—	1902	Perkins, Tex.	S.C.+S.F.	Sand	Poor	60	Cut	—	Heavy	1905	3.75	100	—	—	3	Started to fail in 1904	11.00
	UNTREATED																						
9.1	—	—	—	110	—	—	1909	Lines East	C.B.+Q.	Cinders Gravel Some Slag	—	75-85 90	—	Partly	—	1914	5	8X2	—	—	—		5.00
9.2	—	—	—	23	—	—	1910	do	do	Gravel	—	90	—	do	—	do	4	20.1	—	—	—		5.00
9.3	—	—	—	58	—	—	1909	Lines West	do	Cinders Gravel Some Slag	—	75-85 90	—	Yes	—	do	5	71.0	—	—	—		5.00
9.4	—	—	—	15	—	—	1910	do	do	do	—	do	—	do	—	do	4	0	—	—	—		5.00
9.5	—	—	—	100	—	—	1902	Beaumont, Tex.	S.C.+S.F.	Sand	Poor	60	Cut	None	Heavy	1906	4.25	100	—	—	Holes	9% out in 1905	11.00
	ZINC CHLORIDE																						
10.1	—	—	—	200 to 2000	M.P. 5%	—	1895-6	Prospect	Impon. R.R.	—	Poor	—	—	—	—	1896	18	41	Rot	—	—		29.00
10.2	—	—	—	do	do	—	do	do	do	—	Good	—	—	—	—	do	10	29.5	do	—	—		29.00
10.3	—	—	—	—	40	—	—	Switzerland	Hard Pine Bolts	—	—	—	—	—	—	—	—	—	—	—	10	Life untreated 2 to 3 Years	2.00
10.4	—	—	—	—	—	—	—	Germany	Impon. R.R.	—	—	—	—	—	—	—	—	—	—	—	9	General Statement	do
10.5	—	—	—	4000	—	—	—	do	do	—	—	—	—	—	—	—	—	—	—	—	21	Based on removals to 1909	20.00
	ZINC CHLORIDE - BURNETT																						
11.1	—	—	—	186	—	0.5	1909	Lines East	C.B.+Q.	Cinders Gravel Some Slag	—	75-85 90	—	Partly	—	1914	5	2.0	Rot	—	—		5.00
11.2	—	—	—	104	—	do	1910	do	do	Cinders	—	90	—	All	—	do	4	0	—	—	—		5.00
11.3	—	—	—	60	—	do	1909	Lines West	do	Cinders Gravel Some Slag	—	75-85 90	—	Yes	—	do	5	1.67	—	—	—		5.00
11.4	—	—	—	44	—	do	1910	do	do	Cinders Stone	—	90	—	do	—	do	4	0	—	—	—		5.00
11.5	—	—	—	99	—	0.41	1902	Beaumont, Tex.	S.C.+S.F.	Sand	—	60	Cut	Holes	Heavy	1912	10	76	—	—	—	Began to fail 1911	11.00
11.6	—	—	—	5,876,175	—	0.5	1903	—	I.C.	—	—	—	—	—	—	1908	5	0	—	—	26.10	Includes Oak	1.00
11.7	—	—	—	9957	—	—	1901	Ridley, Pa.	Pa. Lines	—	—	—	—	—	—	1906	5	0	—	—	—		1.30
11.8	—	—	—	13.835	—	—	1908	do	do	—	—	—	—	—	—	do	4	0	—	—	—		1.30
11.9	—	—	—	—	30# Gal	—	—	Germany	Union Ry.	—	—	—	—	—	—	1898	—	—	—	—	9		13.00
11.10	6'-8"-9'	Stood	Air Seasoned	590	—	0.5	1911	Minerals, Miss.	C.M.+St.P.	Gravel	Good	90	Cut	None	Heavy	1915	4	0.2	—	—	Good	Removed - broken	0.00

① - Includes Maple and Red Oak
② - Includes Gum and Elm - Pressure 75# for 30 Min - Maximum Pressure 175# for 2 Hours - Final Vacuum 24 Inch for 20 Min.
③ - Includes Chestnut Elm and Gum
④ - Damaged by derailment
⑤ - Preliminary Vacuum 24 Inch for 45 Min - Maximum Pressure 100# for 1 Hour - 45 Min.

2.1	—	—	—	975	—	8.48	1907	Alexandria VA	CVRR	—	—	—	—	—	—	1916	18	—	—	Butt 12.5	—	[illegible]	4.00
4.1	—	—	—	—	—	—	1915	Seaward, Miss	AV&NW	—	—	—	—	—	—	1916	4.0	10.0	—	—	—	Seaward 1909 - No further data	38.00
	PRESERVATIVE NOT KNOWN																					
	CARBOLINEUM - AVENARIUS																					
4.1	—	—	Seasoned	—	—	—	1909-10	Alexandria	Alexandria Municipal	—	—	—	—	Yes	—	1910	5-6	—	—	—	—	Heavy creosoted spike holes	59.00
	TABLE 5 - CHESTNUT																					
	CREOSOTE - FULL CELL																					
1.1	7-9-8-6"	—	Steamed	88	—	—	1909	Greenbrier Md	D.L.&W.	Stone	Good	101	Good	Williamsport	—	1913	8	—	—	—	—	—	44.00
1.2	do	—	—	95	—	—	do	do	do	do	do	101	do	do	—	do	8	—	—	—	—	—	do
	CREOSOTE - LOWRY																					
2.1	7-9-8-6"	—	Seasoned	733	3.68 cu	—	1912	Bethany, N.J.	D.L.&W.	Stone	Good	101	Brown	D.L.&W.	—	1915	3	0	—	—	—	—	44.00
	CREOSOTE - LOW PRESSURE																					
3.1	—	None	Seasoned	512	3.45 Gal	8.5	1910	Dover N.J.	Lackawanna	—	—	—	—	Yes	—	1911	1	0	—	—	—	—	22.00
	OIL - FUEL - LOW PRESSURE																					
4.1	—	None	Seasoned	278	2.86 Gal	6.7	1910	do	do	—	—	—	—	do	—	do	1	0	—	—	—	—	do
	UNTREATED																					
5.1	—	—	—	165	—	—	1909	Lewes East	C.B.&Q.	Cowden Gravel Quarry	—	75-85	—	Bailey	—	1914	5	11.8	Rot-Split	—	—	—	5.00
5.2	—	—	—	90	—	—	do	Lewes West	do	do	—	do	—	Yes	—	do	5	9.3	Sticky	—	—	—	do
5.3	—	—	—	4,837 BM	—	—	Unknown	N.J. & Penna	C.R.R. of N.J.	—	—	—	—	do	—	1917-8	—	18.5	—	—	—	Includes Oak & Yellow Pine	1.10
5.4	—	—	—	21,200	—	—	1905	Kentucky	I.C.	—	—	—	—	—	—	1910	4-5	10.0	—	—	4.0	do	do
5.5	—	—	—	5760	—	—	1917	Penna.	P.R.R.	—	—	—	—	—	—	do	13	10.0	—	—	11.00	Includes Oak & Yellow Pine	1.87 M.B.
5.6	—	—	—	2816	—	—	1908	do	do	—	—	—	—	—	—	do	7	8.50	—	—	6.5	do	do
5.7	7-9-8-6"	—	Steamed	16	—	—	1918	Bethany N.J.	D.L.&W.	Stone	Good	101	Brown	D.L.&W.	—	1915	3	—	—	—	—	—	44.00
	WOOD TAR CREOSOTE - DIPPED 1 HOUR																					
6.1	—	—	—	2	—	—	1914	Altoona, Pa.	B. Lines	—	—	—	—	—	—	1914	—	—	Dry Rot	—	13	—	30.10
	WOOD TAR CREOSOTE																					
7.1	—	—	—	32	—	—	1914	Howard, Cal.	B. Lines	—	—	—	—	—	—	1916	—	—	Dry rot	—	5.5	Includes Oak & Yellow Pine	30.10
	ZINC CHLORIDE - BURNETT																					
8.1	—	—	—	21	—	8.5	1911	Markleton, Md.	C.M.St.P.	Ground	Good	90	Brown	Yes	Heavy	1914	3	0	—	—	—	4.0 T Burlly dressed Heavy Spikes 1.25	27.00
	ZINC CREOSOTE - CARD																					
9.1	—	—	—	165	—	6.5 Zinc 3.5 Creo	1909	Lewes East	C.B.&Q.	Cowden Gravel Quarry Clay	—	75-85	—	Bailey	—	1914	5	11.2	Broken in Quarry	—	—	—	5.00
9.2	—	—	—	89	—	do	do	Lewes West	do	do	—	do	—	Yes	—	do	5	11.0	do	—	—	—	do
	TABLE 6 - COTTONWOOD																					
	CREOSOTE FULL CELL																					
1.1	—	—	—	85	—	9.96	1909	Lewes East	C.B.&Q.	Cowden Gravel Quarry Clay	—	75-85	—	Bailey	—	1914	5	0	—	—	—	—	5.00
1.2	—	—	—	37	—	do	do	Lewes West	do	do	—	do	—	Yes	—	do	5	0	—	—	—	—	do
	UNTREATED																					
2.1	—	—	—	56	—	—	do	Lewes East	do	do	—	do	—	Bailey	—	do	5	9.8	Rot	—	—	—	do
2.2	—	—	—	30	—	—	do	Lewes West	do	do	—	do	—	Yes	—	do	5	11.0	do	—	—	—	do
	ZINC CREOSOTE - CARD																					
3.1	—	—	—	286	—	6.5 Zinc 3.0 Creo	do	Lewes East	do	do	—	do	—	Bailey	—	do	5	11.0	—	—	—	—	do
3.2	—	—	—	160	—	do	do	Lewes West	do	do	—	do	—	Yes	—	do	5	11.25	—	—	—	—	do
	ZINC TANNIN - WELLHOUSE																					
4.1	—	—	—	87	—	—	1910	Topeka, Kan.	A.T.&S.F.	—	—	—	—	—	—	1913	14.0	12.6	Rot	—	11-12	12.4 pcs 1.16 untreated	2.00
4.2	—	—	—	50	—	—	do	La Junta, Colo.	do	—	—	—	—	—	—	1917	15	12.0	do	—	—	Seasoned destroyed by moths	do
	COTTONWOOD, WHITE																					
	ZINC TANNIN - WELLHOUSE																					
5.1	—	—	—	49	—	—	do	La Junta, Colo.	A.T.&S.F.	—	—	—	—	—	—	1917	15	8.4	Rot	—	—	—	2.00
	TABLE 7 - CYPRESS																					

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	ZINC CHLORIDE - PRESSURE																						
12.1	—	—	—	81002	—	—	1852	Germany	Hanover	—	—	—	—	—	—	1867	15	345	Decay	—	14.8	—	240, 21.90
12.2	—	—	—	680	—	—	do	do	Brunswick	—	—	—	—	—	—	do	15	420	do	—	13	—	do
	ZINC CREOSOTE - ALLARDYCE																						
13.1	—	—	—	50	—	0.06 Zinc 2.0 Creo.	1902	Beaumont, Tex.	G.C.& S.F.	Sand	Poor	60	Cut	None	Heavy	1918	10	80	—	—	—	80% removed 1911	11.00
	ZINC CREOSOTE - CARD																						
14.1	—	—	—	435	—	0.5 Zinc 2.0 Creo.	1909	Lucas East	C.B.& G.	Chickasha Gravel Gravel City	—	90	—	Partly	—	1914	5	0.4	—	—	—	—	5.00
14.2	—	—	—	370	—	do	1910	do	do	Sheridan Gravel	—	90	—	All	—	do	4	0	—	—	—	—	5.00
14.3	—	—	—	37	—	do	1911	do	do	do	—	75	—	Yes	—	do	3	0	—	—	—	—	5.00
14.4	—	—	—	240	—	do	1909	Lucas West	do	Chickasha Gravel Gravel City	—	90	—	do	—	do	5	0	—	—	—	—	5.00
14.5	—	—	—	177	—	do	1910	do	do	Lucas Stone	—	90	—	do	—	do	4	0	—	—	—	—	5.00
14.6	7'-9"-8.5'	sawn	rough seasoned	1107	—	0.5 Zinc 2.0 Creo.	1911	Windsor, Ohio	B.& O.	Gravel	Good	90	Cut	Shoulder Always	Heavy	1915	4	0	—	—	—	Includes Gum	4.90
14.X1	6x8x8	Sawed	Air Seasoned	944	—	do	1912	Lake, Wis.	C.M.& P.	Cinder	do	85	do	None	Average	1916	3	0	—	—	—	Beech - Stained Sound Heart	6.00
	ZINC CREOSOTE - MUTOERS																						
15.1	—	—	—	58	—	0.3 Zinc	1908	Beaumont, Tex.	G.C.& S.F.	Sand	Poor	60	Cut	None	Heavy	1918	10	100	—	—	6	All removed in 1908	14.00
	ZINC TANNIN - WELL HOUSE																						
16.1	—	—	—	100	—	0.87	1902	do	do	Sand	Poor	60	Cut	None	Heavy	1912	10	0	—	—	—	16 Partially decayed	11.00
								TABLE 3 - RED BIRCH														
	CREOSOTE FULL CELL																						
1.1	—	—	—	45	—	—	1910	Hanover, Ill.	C.B.& G.	Sheridan Gravel	—	90	—	All	—	1914	4	0	—	—	—	—	5.00
1.2	—	—	—	50	—	—	do	Wheeling, Ill.	do	do	—	do	—	do	—	do	4	0	—	—	—	—	5.00
1.3	—	—	—	14	—	—	1911	Baden, Ill.	do	Gravel	—	35	—	Except Sand Pockets	—	do	3	0	—	—	—	—	5.00
1.4	—	—	Seasoned 1st after treating	59	—	—	1910	Barr, Colo.	do	Lyons Stone	Very Dry	90	—	Yes	—	1912	2	0	—	—	—	—	5.00
	UNTREATED																						
2.1	—	—	—	91	—	—	1909	Lucas East	C.B.& G.	Chickasha Gravel Gravel City	—	90	—	Partly	—	1914	5	100	—	—	—	Avg. Life Less than 4 yrs.	5.00
2.2	—	—	—	49	—	—	1910	do	do	Sheridan Gravel	—	90	—	All	—	do	4	do	—	—	—	do	5.00
2.3	—	—	—	49	—	—	1909	Lucas West	do	Chickasha Gravel Gravel City	—	90	—	Yes	—	do	5	do	—	—	—	do	5.00
2.4	—	—	—	30	—	—	1910	do	do	Lyons Stone	—	90	—	do	—	do	4	95	—	—	—	do	5.00
	ZINC CHLORIDE - BURNETT																						
3.1	—	—	—	45	—	0.5	1910	Hanover, Ill.	C.B.& G.	Sheridan Gravel	—	90	—	All	—	1914	4	0	—	—	—	—	5.00
3.2	—	—	—	58	—	0.5	do	Wheeling, Ill.	do	do	—	do	—	do	—	do	4	0	—	—	—	—	5.00
3.3	—	—	Seasoned 1 yr. after Treatment	30	—	0.5	do	Barr, Colo.	do	Lyons Stone	Very Dry	do	—	Yes	—	do	4	0	—	—	—	—	5.00
	ZINC CREOSOTE - CARD																						
4.1	—	—	—	433	—	0.5 Zinc 2.0 Creo.	1909	Lucas East	C.B.& G.	Chickasha Gravel Gravel City	—	90	—	Partly	—	1914	5	1	Split	—	—	—	5.00
4.2	—	—	—	276	—	do	1910	do	do	Gravel	—	90	—	All	—	do	4	0	—	—	—	—	5.00
4.3	—	—	—	238	—	do	1909	Lucas West	do	Chickasha Gravel Gravel City	—	90	—	Yes	—	do	5	0	—	—	—	24% Split	5.00
4.4	—	—	—	182	—	do	1910	do	do	Lyons Stone	—	90	—	do	—	do	4	0	—	—	—	3% Split	5.00
								TABLE 4 - CEDAR															
	UNTREATED																						
1.1	—	—	—	329,774	—	—	1856	Nebraska	C.B.& Q.	—	—	—	—	—	—	1910	4	17.5	—	—	—	Includes Pine and Basswood	1.10
1.2	—	—	—	450,300	—	—	1901	Wyo. & Mont.	do	—	—	—	—	—	—	do	9	11.5	—	—	—	do do Fir	1.10
1.3	—	—	—	83,200	—	—	1900	Canada	G.T.	—	—	—	—	—	—	do	10	6.1	—	—	—	—	1.10
1.4	—	—	—	11,117	—	—	1878	Mich. Mich.	C.R.& Ind.	—	—	—	—	—	—	1914	16	100	—	—	—	Includes Oak	1.10 1.15
1.5	—	—	—	377,440	—	—	1903	Ont. Canada	T.N.O.	—	—	—	—	—	—	1910	6 to 7	27.8	—	—	—	do Hemlock and Basswood	1.10
1.6	—	—	—	114,880	—	—	1911-08	Wis	Northern	—	—	—	—	—	—	1910	10 to 11	35.0	—	—	—	Hemlock Basswood Spruce Jack Pine Tamarack	1.10
1.7	7'-8"-8'	—	—	14.25	—	—	1904	Mahall	G.N.	Gravel	Good	8 A 65	5% to 8%	None	—	1914	10	22.8	Rot	—	—	do do	48.00
1.8	do	—	—	965	—	—	do	do	do	do	do	do	do	do	—	do	10	22.8	do	—	—	do do	48.00
1.9	do	P.I.	—	508	—	—	1902	Canada Wis.	C.R.& P.	do	do	do	do	do	do	1912	10	22.8	do other	Dia.	—	—	8.10
1.10	6'-6"-8'	Round (Saw)	—	1,111	—	—	1911	Hayes, Wis.	do	Cinder	do	do	do	do	do	do	10	22.8	do	do	—	—	do

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2.1	—	—	—	300	—	—	1910	Gravel Bend, Miss.	C.R.I. & G.	—	—	—	—	—	—	1910	15	100	—	Zinc Chl.	—	1/2 lb. removed 1920 - Last time removed as piles broken faster	15.00
2.2	—	—	—	—	—	—	1910	Lehigh and Interchange Division	do	—	—	—	—	—	—	do	—	100	—	—	—	as sandy gravel repellent to gas Guard Channels for Delivery Some Were Still in Service	15.00
	CREOSOTE - FULL CELL																						
2.3	—	—	—	15	—	—	1910	Hanover, Tex	C. B. & G.	Alternative Gravel	—	90	—	All	—	1914	4	0	—	—	—		5.00
2.4	—	—	—	19	—	—	do	Hensley, Tex	do	do	—	do	—	do	—	do	do	do	—	—	—		5.00
2.5	—	—	—	29	—	—	do	Burr, Colo.	do	Lyons Shore	Very Dry	do	—	Yes	—	do	do	do	—	—	—		5.00
	OIL - CRUDE																						
3.1	—	—	—	3	—	—	1911	Bodcau, Tex	do	Gravel	—	75	—	Partly Creosoted	—	1912	1	0	—	—	—		5.00
	UNTREATED																						
4.1	—	—	—	114	—	—	1909	Lines East	do	Cypress Gravel Bunch Clay	—	75 to 90	—	Partly	—	1914	5	39.2	Rot	—	—		5.00
4.2	—	—	—	25	—	—	1910	do	do	Gravel	—	90	—	All	—	do	4	4.0	do	—	—		5.00
4.3	—	—	—	60	—	—	1909	Lines West	do	Cypress Gravel Bunch Clay	—	75 to 90	—	Yes	—	do	5	52.3	do	—	—		5.00
4.4	—	—	—	29	—	—	1910	do	do	Lyons Shore	—	90	—	do	—	do	4	3	do	—	—		5.00
4.5	7'-9" x 9'	—	—	6875	—	—	do	Lafayette and Bunkie	C.R.I. & G.	Gravel	—	90	Screw	Giant Termites	—	do	4.5	0	Dead	—	—		7.00
4.6	7'-8" x 9'	—	—	500	—	—	1905	Bay Shore to Bay Tower	do	do	—	—	—	Moderate	—	do	9	31.8	—	—	—	2.98% not due to original	7.00
4.7	do	—	—	500	—	—	do	do	do	do	—	—	—	None	—	do	9	33.8	—	—	—	31.8% do	7.00
4.24	7'-9" x 8'	—	—	2890	—	—	1909	do	do	do	—	90	Screw	Clark	—	do	5	0	Dead	—	—	Hay need renewals next year	7.00
4.25	do	—	—	3637	—	—	do	do	do	do	—	do	do	do	—	do	5	0	do	—	—	do	7.00
① 4.26	—	Hewn	—	882	—	—	1895	Watkins Cutoff	do	Dirt	—	—	—	Yes	—	do	19	38.5	—	—	—	Tache Cypress	7.00
① 4.27	—	do	—	580	—	—	do	do	do	do	—	—	—	None	—	do	19	9.8	—	—	—	do do	7.00
② 4.28	—	do	—	44	—	—	do	do	do	Rock	—	—	—	Yes	—	do	19	100	—	—	—	Hermanites do	7.00
② 4.29	—	do	—	75	—	—	do	do	do	Earth	—	—	—	None	—	do	19	57.5	—	—	—	do do	7.00
③ 4.30	—	Sawed	—	641	—	—	do	do	do	Rock	—	—	—	Yes	—	do	19	100	—	—	—	Calcasieu do	7.00
③ 4.31	—	do	—	396	—	—	do	do	do	Earth	—	—	—	do	—	do	19	91.4	—	—	—	do do	7.00
③ 4.32	—	do	—	658	—	—	do	do	do	do	—	—	—	None	—	do	19	75.7	—	—	—	do do	7.00
4.33	—	—	Not Seasoned	274	—	—	1909	Lula, Miss.	I.C.	Not Graded	—	75	—	Partly Creosoted	—	do	—	—	—	—	—	Damaged by abrasion of Tudor angle bars.	12.00
4.34	—	—	do	274	—	—	do	do	do	do	—	do	—	do	—	do	—	—	—	—	—	do	12.00
4.35	—	—	do	274	—	—	1910	Greenville, Miss	do	Dirt	—	do	—	Partly Creosoted	—	1915	—	0	Normal Rot	—	—	Weber Joints	12.00
4.36	—	—	—	242328	—	—	1907-8	Missouri	C.B.&Q.	—	—	—	—	—	—	1910	6-7	18	—	—	—	Includes White Oak	1.10
4.37	—	—	—	175500	—	—	1907	Louisiana	C.R.I. & P.	—	—	—	—	—	—	do	3	19	—	—	—	Includes White Oak, Pine & Gum	do
4.38	—	—	—	236160	—	—	1905	Arkansas	M.H. & L.	—	—	—	—	—	—	do	5	62	—	—	—	Includes White Oak & Red Oak	do
4.39	—	—	—	294	—	—	1910	Greenville, Miss.	I.C.	Dirt	—	75	—	Partly Creosoted	—	1913	3	0	—	Normal Rot	—	Weber Joints	12.00
	ZINC CHLORIDE - BURNETT																						
5.1	—	—	—	15	—	0.5	1910	Hanover, Tex	C. B. & G.	Florida Gravel	—	90	—	All	—	1914	4	0	—	—	—		5.00
5.2	—	—	—	10	—	do	do	Hensley, Tex	do	do	—	do	—	do	—	do	4	0	—	—	—		5.00
5.3	—	—	Seasoned 1/2 after Treating	30	—	do	do	Burr, Colo.	do	Lyons Shore	Very Dry	do	—	Yes	—	do	4	0	—	—	—		5.00
	ZINC CREOSOTE - CARD																						
6.1	—	—	—	394	—	0.5 Zinc 2.5 Creo.	1909	Lines East	C.B.&Q.	Cypress Gravel Bunch Clay	—	75 to 90	—	Partly	—	1914	5	0	—	—	—		5.00
6.2	—	—	—	24	—	do	1910	do	do	Gravel	—	90	—	All	—	do	4	0	—	—	—		5.00
6.3	—	—	—	288	—	do	1909	Lines West	do	Cypress Gravel Bunch Clay	—	75 to 90	—	Yes	—	do	5	0	—	—	—		5.00
6.4	—	—	—	47	—	do	1910	do	do	Lyons Shore	—	90	—	do	—	do	4	0	—	—	—		5.00
										CYPRESS - RED													
	UNTREATED																						
7.1	—	—	—	1890	—	—	1895	Louisiana	I.C.	—	—	—	—	—	—	1909	14	4	—	—	—		12.20

① Average life (estimated by Forest Service) for Index Nos 4.26 and 4.27 combined was 12.97 Years.
② do do do do 4.28 and 4.29 do do 12.95 do
③ do do do do 4.30, 4.31 and 4.32 do do 15.67 do

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
										CYPRESS - YELLOW													
	UNTREATED																						
B.1	—	—	—	1679	—	—	1906	Memphis	I.C.	—	—	—	—	—	—	1909	3	35	—	—	—		13.20
B.2	7×9	—	—	48000	—	—	1902	do	do	—	—	—	—	—	—	do	7	40	—	—	—		do
B.3	do	—	—	19200	—	—	1900	do	do	—	—	—	—	—	—	do	9	60	—	—	—		do
B.4	do	—	—	67800	—	—	1899	do	do	—	—	—	—	—	—	do	10	60	—	—	—		do
B.5	6×8	—	—	34000	—	—	1901	do	do	—	—	—	—	—	—	do	8	60	—	—	—		do
B.6	7×9	—	—	25800	—	—	Before 1902	Vicksburg	do	—	—	—	—	—	—	do	Burnt	80	—	—	—		do
B.7	do	—	—	25800	—	—	do	do	do	—	—	—	—	—	—	do	do	100	—	—	—		do
										TABLE 8 ELM-WHITE													
	CREOSOTE FULL CELL																						
1.1	—	—	—	106	—	12.97	1909	Lines East	C.B.&Q.	Cinders, Gravel, Burnt Clay	—	70-85 lbs	—	Partly	—	1914	5	2.8	Broken	—	—		5.00
1.2	—	—	—	99	—	do	1910	do	do	Gravel	—	90	—	All	—	do	4	0	—	—	—		do
1.3	—	—	—	58	—	do	1909	Lines West	do	Cinders, Gravel, Burnt Clay	—	70-85 lbs	—	Yes	—	do	5	0	—	—	—		do
1.4	—	—	—	60	—	do	1910	do	do	Lyons Stone	—	90	—	do	—	do	4	0	—	—	—		do
	CRUDE OIL																						
2.1	—	—	—	2	—	—	1911	Bodcaw, Ark.	do	Gravel	—	75	—	Except Bad Joints	—	do	3	0	—	—	—		do
	UNTREATED																						
3.1	—	—	—	89	—	—	1909	Lines East	do	Cinders, Gravel, Burnt Clay	—	70-85 lbs	—	Partly	—	do	5	35.2	Rot	—	—		do
3.2	—	—	—	30	—	—	1908	do	do	Gravel	—	90	—	On Curves	—	do	6	100	do	—	—	76% Rot - 20% Broken - 4% Burned	do
3.3	—	—	—	85	—	—	1910	do	do	Sheridan Gravel	—	90	—	All	—	do	4	32.0	do	—	—		do
3.4	—	—	—	60	—	—	1909	Lines West	do	Cinders, Gravel, Burnt Clay	—	70-85 lbs	—	Yes	—	do	5	20.0	do	—	—		do
3.5	—	—	—	30	—	—	1908	do	do	Lyons Stone	Very Dry	90	—	do	—	do	4	3.0	do	—	—		do
	ZINC CHLORIDE - BURNETT																						
4.1	—	—	—	77	—	0.5	1909	Lines East	do	Cinders, Gravel, Burnt Clay	—	70-85 lbs	—	Partly	—	do	5	2.6	—	—	—		do
4.2	—	—	—	146	—	do	1910	do	do	Sheridan Gravel	—	90	—	All	—	do	4	—	—	—	—	2 Split - 1 Broken - 1 Shaky	do
4.3	—	—	—	43	—	do	1909	Lines West	do	Cinders, Gravel, Burnt Clay	—	70-85 lbs	—	Yes	—	do	5	0	—	—	—		do
4.4	—	—	—	30	—	do	1908	do	do	Lyons Stone	Very Dry	90	—	do	—	do	4	0	—	—	—		do
	ZINC CREOSOTE - CARD																						
5.1	—	—	—	444	—	4.5 Rings 2.0 Cross	1909	Lines East	do	Cinders, Gravel, Burnt Clay	—	70-85 lbs	—	Partly	—	do	5	—	—	—	—		do
5.2	—	—	—	195	—	do	1908	do	do	Gravel	—	90	—	On Curves	—	do	6	0	—	—	—		do
5.3	—	—	—	149	—	do	1910	do	do	do	—	90	—	All	—	do	4	—	—	—	—		do
5.4	—	—	—	165	—	do	do	do	do	Piling Shreveport Sand	—	66	—	None	—	do	4	0.6	—	—	—		do
5.5	—	—	—	244	—	do	1909	Lines West	do	Cinders, Gravel, Clay, Stone	—	70-85 lbs	—	Yes	—	do	5	2.8	—	—	—		do
5.6	—	—	—	121	—	do	1910	do	do	Lyons Stone	Very Dry	90	—	do	—	do	4	—	—	—	—		do
										ELM													
	CRESOL - CALCIUM - NO STEAMING																						
6.1	—	—	Seasoned	9	—	0.5	1910	Greenville, Miss.	I.C.	Dirt	—	75	—	4 Thrubolt Joints	—	1913	3	0	—	Short Top Decay	—	Show decay where in contact with Earth - Weber Joints.	12.00
										TABLE 9 - FIR-RED													
	CREOSOTE - FULL CELL																						
1.1	7"-8"×8'	—	—	224	124 Gal	2.75	1910	Bolton, Miss.	Anacoach Miss. P.O.	Rock	Floor	90	Single	Cobb's Sill	Heavy	1911	1	—	—	—	—		24.00
	ZINC CHLORIDE - BURNETT - ZINC CREOSOTE - ALLARDYCE - CREOSOTE - PWE PINE																						
2.1	—	—	—	61	—	—	1906	Sheridan, Wyo	C.B.&Q.	Gasconfire Gravel	—	85	—	Sullivan	—	1914	8	19.7	Decay	—	—	Includes Lodgepole Pine	5.00
										FIR													
	COPPER SULPHATE BOILED																						
3.1	—	—	—	36640	—	—	1850	Berlin, Germany	R.M.R.R.	—	—	—	—	—	—	1916	16	66.2	—	—	14		27.70 7.60
	COPPER SULPHATE - STEEPED																						
4.1	—	—	—	68000	—	—	1851	do	L.&N. R.R.	—	—	—	—	—	—	1908	17	69.0	—	—	12.9		do

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	CREOSOTE - OIL MIXTURE - CREOSOTE																						
5.1	—	—	—	44,000	—	—	1907-08	Germany	N. W. R.R.	—	—	—	—	—	—	1886	15	Pin.	—	—	15	—	2.75
	CREOSOTE																						2.45
6.1	—	—	—	—	—	—	—	do	G.T.A. R.R.	—	—	—	—	—	—	—	—	—	—	—	10-15	—	6.40
	SALTS - BARRICHELL WASSERMAN																						
7.1	—	—	—	15597	—	—	1908	—	C.B.&Q.	—	—	—	—	—	—	1908	8	Pin.	—	—	—	Broad Rails	1.00
	PRESERVATIVE NOT KNOWN																						
8.1	—	—	—	313000	—	—	1906	Wyoming	do	—	—	—	—	—	—	1910	4	Pin.	—	—	—	Inchoate Plate	1.10
	UNTREATED (SEE CEDAR TABLE 4-A2)																						
9.1	—	—	—	882 487	—	—	—	Germany	St. Rys.	—	—	—	—	—	—	1890	—	—	—	—	22	—	9.26
9.2	—	—	—	79200	—	—	1895-7	do	—	—	—	—	—	—	—	do	11	Pin.	—	—	20	—	29.90
9.3	—	—	—	116800	—	—	1894	do	Schleswig	—	—	—	—	—	—	do	18	Pin.	—	—	26	—	do
9.4	—	—	—	188585	—	—	1898	do	L. Arnold	—	—	—	—	—	—	do	12	Pin.	—	—	19	—	do
9.5	—	—	—	68891	—	—	1894	do	T. Inter	—	—	—	—	—	—	do	13	Pin.	—	—	24	—	do
	VARIOUS PROCESSES																						
10.1	6% unfixed	—	—	69 841	—	—	—	do	—	—	—	—	—	—	—	—	—	—	—	—	19	13 Railroads - Inchoate Plate	do
	ZINC CHLORIDE - BURNETT																						
11.1	—	—	—	2,000 000	—	0.27	1895	—	S.P.	—	—	—	—	—	—	1898	15	—	—	Under Ryder	11-12	Inchoate Plate	4.00
11.2	—	—	—	4,886,648	—	0.25-0.5	1899	—	C.B.&Q.	—	—	—	—	—	—	do	9	—	—	—	10-12	do Ryders removed made inactive	do
11.3	—	—	—	—	—	0.25	1900	—	U.P.	—	—	—	—	—	—	do	6	—	—	—	10-12	do	do
11.4	—	—	—	—	—	0.78	1904	—	G.N.	—	—	—	—	—	—	do	4	0	—	—	—	do	do
11.5	—	—	—	161 905	—	—	1899-0	Germany	Re-treated by	—	—	—	—	—	—	1899	24	16.3	—	—	22.0	Lifts untreated 2.5 years	19.20
	ZINC CHLORIDE																						2.40
12.1	—	—	—	—	—	—	—	Switzerland	S.U.G.B.	—	—	—	—	—	—	—	—	—	—	—	10-14	do 7-8	2.00
	ZINC TANNIN - WELLHOUSE																						
13.1	7'-9"x8'	—	—	—	—	0.78	1886	—	U.P.	—	—	—	Cut	—	—	—	—	—	—	—	6-8	Split in Spiking	do
													FIR. DOUGLAS										
	CREOSOTE - FULL CELL																						
14.1	7'-9"x8'	Sawn	Seasoned	173	—	6.2	1906	Maywood, Mich	N.P.	Good	Good	85	Cut	Flat	Heavy	1915	8.3	21.3	—	Poor	—	—	25.00
14.2	do	do	do	46	—	do	do	do	do	do	do	do	Butt Joints	do	do	do	do	15.3	—	—	—	—	do
14.3	do	do	do	100	—	do	do	do	do	do	do	do	Sawn	Settlers	do	do	do	6.0	—	—	—	Mill Cut	do
14.4	do	do	do	91	—	do	do	do	do	do	do	do	Cut	House	do	do	do	7.0	—	—	—	Trimmed over	do
14.5	do	do	do	52	—	do	do	do	do	do	do	do	do	Settlers	do	do	do	0	—	—	—	Sawn spikes pierced insert Cornish	do
14.6	—	—	—	1,187 915	—	8-10	do	—	C.B.&Q.	—	—	—	—	—	—	1908	2	0	—	—	—	—	1.00
14.7	—	—	Mill Seasoned	74	—	3.456	1905	Elsberry, Mo	C.B.&Q.	—	—	—	—	Settlers	—	1906	8.5	1.4	—	—	—	Treated 2 days after Logging	5.10
	CREOSOTE - OPEN TANK																						
14.81	—	—	Mill Seasoned	32	—	3.99	do	do	do	—	—	—	—	do	—	do	8.5	—	—	—	—	do	do
	CREOSOTE - DIPPING																						
14.82	—	—	Mill Seasoned	40	—	5.995	do	do	do	—	—	—	—	do	—	do	8.5	0	—	—	—	do	do
	UNTREATED																						
15.1	7'-9"x8'	Hewn	Green	95	—	—	1907	Illinois, Mouth	N.P.	Good	Excellent	22x10	Sawn 22x10 Cut 22x14	Sea Islands	Heavy	1915	8.3	19.0	—	—	2.63	Mill shortened & spiked on 1910 7.27 to 6.0 - Inchoate Treated 28 L. Settlers 2	25.00
15.2	do	do	do	94	—	—	do	do	do	do	do	do	Cut	Unknown	do	do	do	20.0	—	—	2.58	—	do
16.1	do	do	do	108	—	—	do	do	do	do	do	do	Sawn	Settlers	do	do	do	9.2	—	—	2.78	—	do
16.2	do	Sawn	do	264	—	—	1906	Maywood, Mich	do	do	Good	do	Cut	do	do	do	do	6.0	—	—	—	—	do
16.3	do	do	do	46	—	—	do	do	do	do	do	do	Sawn	do	do	do	do	16.8	—	—	—	—	do
16.4	do	do	do	47	—	—	do	do	do	do	do	do	Cut	do	do	do	do	26.1	—	—	—	—	do
16.5	do	do	do	100	—	—	do	do	do	do	do	do	Cut	do	do	do	do	9.0	—	Sawn Sawn	—	—	do
16.6	do	do	do	100	—	—	do	do	do	do	do	do	Cut	House	do	do	do	9.0	—	do	—	—	do
16.7	do	Hewn	do	91	—	—	1909	Illinois, Mouth	do	do	Excellent	do	Cut	Settlers	do	do	do	10.0	—	—	2.56	—	do
16.8	do	do	do	90	—	—	do	do	do	do	do	do	Sawn	do	do	do	do	10.0	—	—	2.71	—	do

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
16.9	7'-9"x8'	Mount	Seasoned	32	—	—	1907	Plains Mont	N.P.	Gravel	Excellent	72	35-55 ft	Cut Mod Humpback	Heavy	1905	8.3	99.0	Considered	Poor	7.63	—	25.00
16.10	〃	〃	〃	90	—	—	〃	〃	〃	〃	〃	85	Cut	〃	〃	〃	〃	91.4	—	—	7.58	—	〃
16.11	〃	〃	〃	90	—	—	〃	〃	〃	〃	〃	〃	〃	Sellers	〃	〃	〃	88.9	—	—	7.56	—	〃
16.12	〃	〃	~	90	—	—	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	92.8	—	—	7.56	—	〃
16.13	〃	〃	〃	180	—	—	〃	〃	〃	〃	〃	〃	35-55 ft	〃	〃	〃	〃	98.9	—	Heavy Knots	7.78	—	〃
16.14	〃	〃	〃	99	—	—	〃	〃	〃	〃	〃	〃	Cut	N.P. 21	〃	〃	〃	95.5	—	Good	7.56	—	〃
16.15	〃	Some	〃	100	—	—	1906	Maynard, Wash.	〃	〃	Good	〃	Cut Some Heavy	Flat	〃	〃	〃	96.0	—	Some Heavy	—	—	〃
16.16	〃	〃	〃	58	—	—	〃	〃	〃	〃	〃	〃	〃	None	〃	〃	〃	95.0	—	—	—	—	〃
16.17	〃	〃	〃	98	—	—	〃	〃	〃	〃	〃	〃	〃	Sellers	〃	〃	〃	99.8	—	—	—	—	〃
16.18	〃	〃	〃	91	—	—	〃	〃	〃	〃	〃	〃	Some 35-55 ft	〃	〃	〃	〃	94.8	—	Some Heavy	—	—	〃
16.19	〃	〃	〃	350	—	—	〃	〃	〃	〃	〃	〃	Cut	〃	〃	〃	〃	95.4	—	—	—	—	〃
16.20	〃	〃	〃	99	—	—	〃	〃	〃	〃	〃	〃	〃	None	〃	〃	〃	96.0	—	Some Heavy	—	Deadly rain storm	〃
16.21	〃	〃	〃	284	—	—	〃	〃	〃	〃	〃	〃	〃	Flat	〃	〃	〃	97.8	—	—	—	Ten Cut in Summer months show more Loss	〃
16.22	6'-6"x8'	Mount	Seasoned Some Unseasoned Ties	64	—	—	1910	Belmont Wash	Mt. Pk. Ry	〃	〃	—	〃	None	Light	〃	4	0	—	—	—	5 partly decayed	40.00
16.23	〃	〃	〃	100	—	—	1906	Maynard Wash	N.P.	〃	〃	85	Some Cut	Flat	Heavy	〃	23	0	—	—	—	Cannot locate	35.00
16.24	—	—	Mill Seasoned	89	—	—	1905	Elchorey No	C.B.&Q.	—	—	—	—	—	—	1914	25	44.9	—	—	—	Top plated 2½ yrs after laying	5.10
16.25	7'-8"x8'	Some	—	137	—	—	1911	N Yakima Iowa	C.M.&St.P.	Cinder	Good	65	Cut	None	Average	1905	4	0	—	—	—	—	8.10
16.26	〃	〃	—	500	—	—	1912	Custer S.D.	〃	〃	Fair	90	〃	Sellers	〃	〃	5	0	—	—	—	—	〃
ZINC CHLORIDE - BURNETT																							
17.1	7'-9"x8'	Some	Partly Seasoned	219	—	0.843	1895	Kansas Mass	S.P.	28 others Mix. Gravel 22 & Earth	—	25-76	Cut 35-55 ft	Mill Stumps and Shavings	Heavy	1914	13	100	All Cross	—	11.36	Avg. 1.18 estimated by Road Service	32.00
17.2	〃	〃	〃	4063	—	〃	1896	〃	〃	〃	—	〃	〃	〃	〃	〃	13	100	〃	—	10.97	〃	〃
17.3	〃	〃	〃	1941	—	〃	1897	〃	〃	〃	—	〃	〃	〃	〃	〃	13	100	〃	—	10.76	〃	〃
17.4	〃	〃	〃	10536	—	〃	1898	〃	〃	〃	—	〃	〃	〃	〃	〃	14	100	〃	—	11.21	〃	〃
17.5	〃	〃	〃	12951	—	〃	1899	〃	〃	〃	—	〃	〃	〃	〃	〃	14	100	〃	—	10.46	〃	〃
17.6	〃	〃	〃	26146	—	〃	1900	〃	〃	〃	—	〃	〃	〃	〃	〃	13	100	〃	—	9.21	〃	〃
17.7	〃	〃	〃	43681	—	〃	1901	〃	〃	〃	—	〃	〃	〃	〃	〃	13	99.57	〃	—	10.15	〃	〃
17.8	〃	〃	〃	52204	—	〃	1902	〃	〃	〃	—	〃	〃	〃	〃	〃	12	99.3	〃	—	9.43	〃	〃
17.9	〃	〃	〃	44056	—	〃	1903	〃	〃	〃	—	〃	〃	〃	〃	〃	11	99.6	〃	—	9.98	〃	〃
17.10	〃	〃	〃	42541	—	〃	1904	〃	〃	〃	—	〃	〃	〃	〃	〃	10	99.3	〃	—	9.44	〃	〃
17.11	〃	〃	〃	53983	—	〃	1905	〃	〃	〃	—	〃	〃	〃	〃	〃	9	99.7	〃	—	9.46	〃	〃
17.12	〃	〃	〃	48498	—	〃	1906	〃	〃	〃	—	〃	〃	〃	〃	〃	8	99.9	〃	—	—	—	〃
17.13	〃	〃	〃	28673	—	〃	1907	〃	〃	〃	—	〃	〃	〃	〃	〃	7	99.0	〃	—	—	—	〃
17.14	〃	〃	〃	44689	—	〃	1908	〃	〃	〃	—	〃	〃	〃	〃	〃	6	99.4	〃	—	—	—	〃
17.15	〃	〃	〃	62146	—	〃	1909	〃	〃	〃	—	〃	〃	〃	〃	〃	5	99.4	〃	—	—	—	〃
17.16	〃	〃	〃	136794	—	〃	1910	〃	〃	〃	—	〃	〃	〃	〃	〃	4	99.9	〃	—	—	—	〃
17.17	〃	〃	〃	149449	—	〃	1911	〃	〃	〃	—	〃	〃	〃	〃	〃	3	0	〃	—	—	—	〃
17.18	〃	〃	〃	148111	—	〃	1912	〃	〃	〃	—	〃	〃	〃	〃	〃	2	—	〃	—	—	—	〃
17.19	〃	〃	〃	154873	—	〃	1913	〃	〃	〃	—	〃	〃	〃	〃	〃	1	—	〃	—	—	—	〃
17.20	〃	〃	〃	118185	—	〃	1914	〃	〃	〃	—	〃	〃	〃	〃	〃	0	—	〃	—	—	—	〃
17.21	〃	〃	〃	90	—	0.786	1907	Plains, Mont	N.P.	Gravel	Excellent	85	Some Cut	Sellers	〃	1905	8.3	11	—	—	—	Now continues where the estimated	25.00
17.22	〃	〃	〃	107	—	〃	〃	〃	〃	〃	〃	〃	35-55 ft	〃	〃	〃	〃	8.7	—	—	—	No decay in 1905	〃
17.23	—	—	Mill Seasoned	91	—	0.862	1905	Elchorey No	C.B.&Q.	—	—	—	—	〃	—	1914	8.5	32	—	—	—	Top plated 2½ yrs after laying	5.10
ZINC CHLORIDE - BOILED																							
18.1	—	—	Seasoned 25%	61	—	—	1908	Sheridan Wy.	〃	—	Poor	—	—	—	Heavy	1912	8	30	Knotted	—	—	All to go out in 1913	5.00
ZINC CREOSOTE - CHLORIDE																							
19.1	—	—	Mill Seasoned	41	—	50% Creo 50% Zinc	1905	Elchorey No	〃	—	—	—	—	Sellers	—	1914	8.5	40	—	—	—	Top plated 2½ yrs after laying	5.10
FIR - GRAND																							
ZINC CHLORIDE - BOILED																							
17.2	6'-6"x8'	Mount	Unseasoned Some Seasoned Ties	8	—	—	1910	Belmont, Wash	Mt. Pk. R.R.	—	Good	—	Cut	None	Light	1914	4	0	Good	—	—	2 partially split	41.00
FIR - OREGON																							
CREOSOTE																							
18.1																							

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2.12	7'-9"-8'	Sound	Sandstone	1000	—	2.0	1909	Indiana, Ore.	Willamette	Gravel	Good	Air dry 25%	—	—	Air dry	1910	5	0.0	—	—	—		2.00
	UNTREATED																					
20.1	—	Sound	Sandstone	1906	—	—	do	do	do	do	do	do	—	—	do	1909	3	0	—	—	—	80% show surface decay	do
20.2	—	do	Soft Sandstone	1907	—	—	do	do	do	do	do	do	—	—	do	do	4	0	—	Poor	—		do
	ZINC CHLORIDE - BURNETT																					
21.1	—	Sound	Sandstone	999	—	0.88	1909	do	do	do	do	do	—	—	do	1910	5	0.0	—	—	—		do
21.2	—	do	Soft Sandstone	995	—	do	do	do	do	do	do	do	—	—	do	do	5	0.0	—	—	—		do
21.3	—	do	Sandstone	1989	—	do	do	do	do	do	do	do	—	—	do	do	5	0.0	—	—	—		do
21.4	—	—	—	45 Pl.	—	—	1908	Nevada	B.B. Line	—	—	—	—	Willamette	—	do	11	35.0	—	Bad Butts	7.4.8	Willamette Probable Shorter life due to B of Sapwood	32.00
21.5	—	—	—	35.6 Pl.	—	—	do	do	do	—	—	—	—	do	—	do	11	38.0	—	—	do	do	do
21.6	—	—	—	18 Pl.	—	—	do	Utah	do	—	—	—	—	—	—	do	11	84.0	—	—	6.4.18	Sap removed & creosote one Oldwick Only portion of sapwood cut from	do
21.7	—	—	—	20 Pl.	—	—	do	Bingo, Utah	do	—	—	—	—	—	—	do	N	70.0	—	—	—	2 B.S years 5.76	do
21.8	—	—	—	6 Pl.	—	—	do	Ley, Utah	do	—	—	—	—	—	—	do	11	98.0	—	—	7	Maximum life 12 years	do
21.9	—	—	—	45 Pl.	—	—	do	Nayo, Utah	do	—	—	—	—	—	—	do	N	—	—	—	Good	—	Show some rot where ground holed used	do
21.10	—	—	—	5 Pl.	—	—	do	Ogden, Utah	do	—	—	—	—	Willamette	—	do	11	92.0	—	—	6	The remainder removed in 1914	do
21.11	—	—	—	200 000 per year	—	0.25	1905-14	New Line	do	—	—	—	—	—	—	—	—	—	—	—	71.9	91% of failures due to decay	do
	ZINC CHLORIDE																					
22.1	—	—	—	5014	—	—	1903	Bingle-Stevens Co.	C.B.&Q.	Slag	—	10 lbs per cu ft	—	Partly	—	1912	9	5.4	All Ground	—	—	Triangular Pins	5.00
	SALT TREATED (GREAT SALT LAKE UTAH) 22.5% SOLIDS																					
22.1	—	—	—	15000	—	—	1899	Great Salt Lake	O.S.L.	—	—	—	—	—	—	1904	5	—	—	—	—	Short on advantage over untreated bin	32.00

TABLE 10 GUM-RED

	CREOSOTE - FUEL CELL																					
1.1	—	—	—	85	—	9.83	1909	Lines East	C.B.+Q	Quarry, Gravel Bank, Clay	—	10 lbs per cu ft	—	Partly	—	1910	5	0	—	—	—		5.00
1.2	—	—	—	48	—	do	do	Lines West	do	do	—	do	—	Yes	—	do	5	0	—	—	—		5.00
1.3	6"-8"-8'	Sound	—	28	33.31	12.52	1905	Bay Head, Jct. Old Town, Me.	B.M.R.S.A	—	—	—	Screw	—	—	do	9	42.8	—	—	—	Started to fail 1908	7.00
1.4	do	do	—	37	do	do	do	do	do	—	—	—	—	Glandon	—	do	9	38.3	—	—	—	do 1912	do
1.5	do	do	—	45	do	do	do	do	do	—	—	—	—	None	—	do	9	38.3	—	—	—	do 1912	do
1.6	do	do	—	36	38.45	14.45	do	do	do	—	—	—	Screw	—	—	do	9	37	—	—	—	No Steaming	do
1.7	do	do	—	29	do	do	do	do	do	—	—	—	—	Glandon	—	do	9	17.2	—	—	—	do	do
1.8	do	do	—	38	do	do	do	do	do	—	—	—	—	None	—	do	9	21.2	—	—	—	do	do
	CREOSOTE - GIUSSANI																					
2.1	—	—	—	48	—	—	do	North Mo.	M.L.+S.R.	—	—	—	—	—	—	do	9	12.6	—	—	—	Includes Red Oak	30.00
2.2	—	—	—	18	—	—	do	do	do	—	—	—	—	—	—	do	9	22.7	—	—	—	do Incomplete record	do
	CREOSOTE - NO STEAMING																					do
3.1	—	—	—	85	—	—	do	do	do	—	—	—	—	—	—	do	9	3.8	—	—	—	do	do
	CREOSOTE - LIVE STEAM IN SUPERHEATED COILS																					
4.1	—	—	—	24	—	—	do	do	do	—	—	—	—	—	—	do	9	4.2	—	—	—	do	do
	CREOSOTE - BETHEL																					
5.1	—	—	—	78	—	—	do	do	do	—	—	—	—	—	—	do	9	4.3	—	—	—	do	do
	CREOSOTE - RIEPING																					
6.1	6"-8"-8'	Sound Specified	Sandstone Type	74	9.53	—	1906	St. Clair, Mo.	do	Gravel	Good	10 lbs per cu ft	Cut	None	Heavy	do	8	0	—	Good	—	Rail changed 1909	do
6.2	do	Partly Specified	do	247	9.88	—	do	do	do	do	do	do	do	do	do	do	8	0	—	do	—	do Includes Red Oak	do
6.3	—	—	—	48	—	—	1905	Pacific, Mo.	do	—	—	—	—	—	—	do	9	3.5	—	—	—		do
	PRESERVER - DIAMOND WOOD																					
7.1	7'-9"-8'	Heart	—	500	0.13 Sol.	0.11 Sol.	1907	Ft. Monroe, Va. Port, Va.	B.M.R.S.A	Slag	—	—	Cut	Glandon	—	do	9	0	—	Good	—		9.00 9.00

① Maximum Pressure 100 ℔ per Sq. in. - Time 1.2 Hours
② Preliminary Steaming 2.5 Hours. - Preliminary Vacuum 25 inch 1.25 Hours - Maximum Pressure 100 ℔ per Sq. in. for 2.75 Hours
③ Left in tube for six months - Penetration of coloring constituents of matter only 3 to 3 inches - Deposits on tree were soluble
④ Preliminary Pressure of 25 ℔ for 4 Hours
⑤ Preliminary Pressure of 80 ℔ for 0.5 Hours - Maximum Oil Pressure 180 ℔ at 190° F. for 8 Hours - Final Vacuum of 26 inch for 4.5 Hours

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	TREATMENT NOT KNOWN																						
8.1	—	—	—	4	—	—	1905	Pacific, Mo.	SL.-S.F.	—	—	—	—	—	—	1914	9	100	—	—	—	—	30.00
	UNTREATED																						
9.1	—	—	—	100	—	—	1909	Lines East	C.B.&Q.	Cowden, Round Bunker City	—	72"-6" 90	—	Partly	—	do	5	87.2	Rot	—	—	—	5.00
9.2	—	—	—	54	—	—	do	Lines West	do	do	—	do	—	Yes	—	do	5	88.8	do	—	—	—	do
9.3	—	—	—	31	—	—	1908	Chicago, Ill.	do	Gravel	—	90	—	Some Curves	—	do	6	100	do	—	—	Track elevated 1910 All out in 1911	do
9.4	6"-8"-8'	Sawed	—	11	—	—	1905	Bay View & Lake Shore, Wis.	C.M.St.P.	—	—	—	Screw	—	—	do	3	100	do	—	2.6	—	7.00
9.5	—	—	—	16	—	—	1905	do	do	—	—	—	—	Slender	—	do	3	100	do	—	2.4	—	do
9.6	—	—	—	14	—	—	do	—	—	—	—	—	—	None	—	do	3	100	do	—	—	—	do
	ZINC CHLORIDE - BURNETT																						
10.1	—	—	—	15	—	0.5	1909	Lines East	C.B.&Q.	Cowden, Round Bunker City	—	72"-6" 90	—	Partly	—	do	5	6.6	Butt split	—	—	—	5.00
10.2	—	—	—	12	—	do	1911	do	do	Gravel	—	75	—	Creosoted Cull Ends	—	do	3	0	—	—	—	—	do
10.3	—	—	—	43	—	do	1909	Lines West	do	Cowden, Round Bunker City	—	72"-6" 90	—	Yes	—	do	5	7.0	Rot	—	—	—	do
10.4	6"-8"-8'	Sawed	—	40	0.7285	0.2938	1905	Bay View & Lake Shore, Wis.	C.M.St.P.	—	—	—	Screw	—	—	do	9	98.0	—	—	7.0	Avg. Life estimated by Forest Service	7.00
10.5	do	do	—	45	do	do	do	do	do	—	—	—	—	Slender	—	do	9	92.2	—	—	7.0	do	do
10.6	do	do	—	44	do	do	do	do	do	—	—	—	—	None	—	do	9	78.5	—	—	6.7	do	do
10.7	do	do	—	32	0.8107	0.3047	do	do	do	—	—	—	Screw	—	—	do	9	93.5	—	—	7.3	do	do
10.8	do	do	—	34	do	do	do	do	do	—	—	—	—	Slender	—	do	9	77.0	—	—	7.0	do Failure started 1909	do
10.9	do	do	—	49	do	do	do	do	do	—	—	—	—	None	—	do	9	89.0	—	—	7.3	do do	do
	ZINC CREOSOTE																						
⊙ 11.1	6"-8"-8'	Sawed	Seasoned 15 days after Treat.	12	1.81 Lins. 1.57 Creo.	0.33 Lins. 0.29 Creo.	do	do	do	—	—	—	Screw	—	—	do	9	25.0	—	—	—	—	7.00
⊙ 11.2	do	do	do	16	do	do	do	do	do	—	—	—	—	Slender	—	do	9	38.3	—	—	—	—	do
⊙ 11.3	do	do	do	17	do	do	do	do	do	—	—	—	—	None	—	do	9	85.3	—	—	—	Started to fail 1910	do
	ZINC CREOSOTE - CARD																						
12.1	—	—	—	414	—	6.2 Lins. 5.0 Creo.	1909	Lines East	C.B.&Q.	Cowden, Round Bunker City	—	72"-6" 90	—	Partly	—	do	5	1.0	Split	—	—	2% more split or broken	5.00
12.2	—	—	—	232	—	do	do	do West	do	do	—	do	—	Yes	—	do	5	0.5	—	—	—	—	do
12.3	—	—	—	194	—	do	1908	do East	do	Gravel	—	90	—	do	—	do	6	8.5	—	—	—	—	do
										GUM - SWEET													
	ZINC CREOSOTE - ALLARDYCE																						
15.1	—	—	—	10	—	6.2 Lins. 5.0 Creo.	1902	Brunswick, Ga.	S.C.Y.S.R.	Sand	Poor	60	Cut	None	Heavy	1912	10	6.5	—	—	—	Started to fail 1905	11.00
	ZINC TANNIN - WELL HOUSE																						
14.1	—	—	—	51	—	—	1902	Topeka, Kas.	A.T.&S.F.	—	—	—	—	—	—	1911	9	88.5	—	—	—	—	2.00
										GUM													
	WOOD TAR CREOSOTE																						
15.1	—	—	—	18	—	—	1902	Fla. & Choctaw	Fla. Lines	—	—	—	—	—	—	1914	12	44	Decay	—	5	Not complete	20.10
	CREOSOTE																						
See	Beech Index Nos. 1.7 and 1.8																					•	4.80+1.00
	CREOSOTE - LOWRY																						
16.1	—	—	—	1,650,000	—	6.3	1904	—	C.C.C.&St.L.	—	—	—	—	—	—	1908	4	—	—	—	Probably Mayo	Included oak	1.00
	CREOSOTE - HUEPING																						
See	Beech Index No. 5.1 and Ash Index Nos 2.1 and 2.2 Also sheet 10a																						
⊙ 17.1	—	—	—	203	—	5.0	1909	Waterloo, Ill.	I.C.	Old Rock	—	90	—	1 Toothed Hewing	—	1913	4	8.49	Broken	Good	—	Continuous Angle bore	12.00
	CRUDE OIL - BOILED																						
18.1	—	—	—	—	—	—	1902	Government No. Div.	S.C.Y.S.R.	Sand	Poor	60	Cut	None	Heavy	1912	10	0	—	—	—	—	11.00

⊙ Air Seasoned 30 days after Live Treatment by Card Creosote Treatment

Ⓓ Preliminary Air 75 Lbs. Sp. In. for 0.5 Hours – Max. Oil Pressure 175 Lbs. Sq. In. for 2 Hours Final Vacuum 26 Inch for 20 Minutes

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CREOSOTE-FUEPING

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
①17.2	——	Same	the Seasons	390	——	5.00	1907	Kirkhouse Rd.	7 to 8 F.	Rock	——	98	Cr°	Th of	9 89 101	1919	7	0	——	——	——	——	45.00
18.3	——	do	do	280	——	5.00	do	do	do	Cinders	——	85	do	do	3 100 100	do	7	0	——	——	——	——	45.00
②7.9	——	do	do	932	——	5.00	do	Pleasance Rd.	do	Rock	——	90	do	do	4 100 101	do	7	3	——	——	——	——	45.00
③13.5	——	do	do	19 497	——	5.00	1910	Kirkhouse Rd	do	do	——	93	Screw	do	——	1915	5	0	——	——	——	——	43.00

② Preliminary air — 100# Pressure for 30 min. Creosote at 200# Pressure for 2 hrs. 30 min at 186° F. Final vacuum - 23 inch 1 hr 30 min
② Preliminary air — 100# Pressure for 30 min. Creosote at 175 Pressure for 3 hrs at 194° F. Final vacuum - 23 inch 2 hr.
③ Tons traffic per annum

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TABLE II GUM-TUPELO

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	VULCANIZED																						
⊙ 18.1	—	Sawed	Impregnated with creosote & zinc chloride	100	—	—	1897	Norfolk Va. Dist	N. S.	—	—	—	—	—	—	1914	9	100	—	—	4.5	Started & Fail 1899 All out 1906	16.00
⊙ 18.2	—	Hewn	do	100	—	—	do	do	do	—	—	—	—	—	—	do	8	100	—	—	2.83	do 1899 do 1905	do
⊙ 18.3	—	Sawed	do	25	—	—	do	do	do	—	—	—	—	Screw	—	do	12	100	—	—	6.72	do 1899 do 1909	do
⊙ 19.4	—	Hewn	do	25	—	—	do	do	do	—	—	—	—	do	—	do	8	100	1	—	2.96	do 1899 do 1905	do
	ZINC CHLORIDE - BURNETT																						
	See ASH - Index Nos 4.3 to 4.7 Inclusive																						
	20.1	—	—	—	3	—	—	1902	Superseded by Creosoted	R.C.+S.A.	Sound	Post	—	Cut	None	Merry	1912	10	33	—	—	—	started to fail in 1911	11.00
	20.2	—	—	—	—	—	—	—	—	I.C.	—	—	—	—	—	—	—	—	—	—	—	do	33.00
	ZINC CREOSOTE																						
	21.1	—	—	—	693,324	—	8.5	1904	—	C.C.C. & W.L.	—	—	—	—	—	—	1908	4	0	—	—	Broken Stubs	Includes Oak	1.00
	ZINC TANNIN - WELLHOUSE																						
⊙	22.1	—	Hewn	Impregnated with Zinc & Tannic Acid Treatment	100	4.22	—	1897	Norfolk Va. Dist	N. S.	—	—	—	—	Screw	—	1914	15	51	—	—	13	Started & Fail in 1907	16.00
⊙	22.2	—	do	do	25	—	—	do	do	do	—	—	—	—	do	—	do	15	64	—	—	16	do 1907	do
⊙	22.3	—	Sawed	do	100	1.36	—	do	do	do	—	—	—	—	do	—	do	17	77	—	—	14	do 1905	do
⊙	22.4	—	do	do	25	—	—	do	do	do	—	—	—	—	do	—	do	15	100	—	—	12	do 1903	do
	CREOSOTE - FULL CELL																						
	1.1	—	—	—	97	—	18.99	1909	Lucas East	C.B.+Q.	Indian Ground Service Pole	—	25 ft 6 in	—	Partly	—	1914	5	0	—	—	—		5.00
	1.2	—	—	—	54	—	do	do	Lucas West	do	do	—	do	—	Yes	—	do	5	0	—	—	—		do
	1.3	6'-8"-8'	Sawed	Impregnated with Creosote	33	29.82	11.21	1905	Gray Horse and Oak Lawn, Tex.	R.H.+S.A.	—	—	—	Screw	—	—	do	9	24.5	—	—	—		7.00
	1.4	do	do	do	36	do	do	do	do	do	—	—	—	—	Slender	—	do	9	30.6	—	—	—		do
	1.5	do	do	do	44	do	do	do	do	do	—	—	—	—	None	—	do	9	22.6	—	—	—		do
⊙	1.6	do	do	do	23	35.18	13.21	do	do	do	—	—	—	Screw	—	—	do	9	43	—	—	—		do
⊙	1.7	do	do	do	30	do	do	do	do	do	—	—	—	—	Slender	—	do	9	16.7	—	—	—		do
⊙	1.8	do	do	do	35	do	do	do	do	do	—	—	—	—	None	—	do	9	22.6	—	—	—		do
	UNTREATED																						
	2.1	—	—	—	88	—	—	1909	Lucas East	C.B.+Q.	Indian Ground Service Pole	—	25 ft 6 in	—	Partly	—	1914	5	97.8	—	—	—		5.00
	2.2	—	—	—	97	—	—	do	Lucas West	do	do	—	do	—	Yes	—	do	5	54.2	—	—	—		do
⊙	2.3	6'-8"-8'	Sawed	—	13	—	—	1905	Gray Horse and Oak Lawn, Tex.	R.H.+S.A.	—	—	—	Screw	—	—	1909	4	100	—	—	2.6		7.00
⊙	2.4	do	do	—	15	—	—	do	do	do	—	—	—	—	Slender	—	1910	5	100	—	—	2.6		do
⊙	2.5	do	do	—	14	—	—	do	do	do	—	—	—	—	None	—	do	5	100	—	—	2.8		do
	ZINC CHLORIDE - BURNETT																						
	3.1	—	—	—	76	—	8.6	1909	Lucas East	C.B.+Q.	Indian Ground Service Pole	—	25 ft 6 in	—	Partly	—	1914	5	1.52	—	—	—		5.00
	3.2	—	—	—	41	—	do	do	Lucas West	do	do	—	do	—	Yes	—	do	5	1.52	—	—	—		do
⊙	3.3	6'-8"-8'	Sawed	—	30	8.57.55	8.22.59	1905	Gray Horse and Oak Lawn, Tex.	R.H.+S.A.	—	—	—	Screw	—	—	do	9	26.8	—	—	7.0	Started & Fail in 1908	9.00
⊙	3.4	do	do	—	37	do	do	do	do	do	—	—	—	—	Slender	—	do	9	29.2	—	—	7.0	do 1910	do
⊙	3.5	do	do	—	46	do	do	do	do	do	—	—	—	—	None	—	do	9	34.5	—	—	7.0	do 1910	do
⊙⊙	3.6	do	do	—	22	0.62.84	0.23.4	do	do	do	—	—	—	Screw	—	—	do	9	100	—	—	7.2	do 1910	do
⊙⊙	3.7	do	do	—	35	do	do	do	do	do	—	—	—	—	Slender	—	do	9	38.9	—	—	7.0	do 1910	do
⊙⊙	3.8	do	do	—	30	do	do	do	do	do	—	—	—	—	None	—	do	9	28.5	—	—	8.0	do 1911	do
	ZINC CREOSOTE - CARD																						
	4.1	—	—	—	435	—	45 Brin 3.5 Ends	1909	Lucas East	C.B.+Q.	Indian Ground Service Pole	—	25 ft 6 in	—	Partly	—	1914	5	1.0	—	—	—		5.00
	4.2	—	—	—	237	—	do	do	Lucas West	do	do	—	do	—	Yes	—	do	5	0	—	—	—	2% split and broken	do
⊙	4.3	6'-8"-8'	Sawed	—	12	4.57.72 Ends 3.33 Ends	4.57.72 Ends 3.33 Ends	1905	Gray Horse and Oak Lawn, Tex.	R.H.+S.A.	—	—	—	Screw	—	—	do	9	23.9	—	—	7.0	Started & Fail in 1910	9.00
⊙	4.4	do	do	—	14	do	do	do	do	do	—	—	—	—	Slender	—	do	9	28.0	—	—	—	do 1911	do
⊙	4.5	do	do	—	10	do	do	do	do	do	—	—	—	—	None	—	do	9	20.0	—	—	8.0	do 1912	do

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HACKBERRY

S.1	ZINC CHLORIDE - QUARRIE	—	—	60	—	—	1908	Ark. Mo. Miss.	C.B.&Q.	—	—	—	—	—	—	1910	15	95	—	Fair	—	Ideal Climate	33.00
C.1	ZINC CREOSOTE - CARR	—	—	45	—	25 Zinc 2.5 Creo.	1911	Miss. Mo.	C.B.&Q.	Burnt Clay	Good	25	—	None	Heavy	1914	3	0	—	Poor	—	—	5.00

TABLE 12. HEMLOCK

1.1	CREOSOTE - FULL CELL	—	—	87	—	7.87	1909	Lewis East	C.B.&Q.	Broken Gravel Burnt Clay	—	90-95	—	Partly	—	1914	5	0	—	—	—	—	5.00
1.2	—	—	—	50	—	〃	1910	〃	〃	Gravel	—	90	—	All	—	〃	4	0	—	—	—	—	〃
1.3	—	—	—	17	—	〃	1911	〃	〃	〃	—	95	—	Gravel Burnt Clay	—	〃	3	0	—	—	—	—	〃
1.4	—	—	—	46	—	〃	1909	Lewis West	〃	Broken Gravel Burnt Clay	—	85-90	—	Yes	—	〃	5	0	—	—	—	—	〃
1.5	—	—	—	52	—	〃	1910	〃	〃	Lyons Stone	Very Dry	90	—	〃	—	〃	4	0	—	—	—	—	〃
1.1	CREOSOTE																						
12.1	6'-8"-8'	Hewn	—	400	—	—	1880	Hickory, Miss.	M.K.&T.W.N.	Gravel	Good	95	Cut	—	Flat Line	1914	22	100	Red Cod	—	20	Old valley had replaced only as way as right post - last removed in 1912	5.00
12.2	—	—	—	—	—	—	1880	Shawnee, Miss.	〃	—	—	—	—	—	—	1914	—	100	—	—	20		5.00
12.3	—	—	—	5000	—	—	1872	Chicago, S.R.	C.R.I.&P.	Gravel	—	—	—	—	Heavy	1892	10	60-80	Red Cedar and Cottonwood	Poor	—	Not properly treated	2.40
2.1	CREOSOTE - OPEN TANK	6'-8"-8'	Hewn	Standard Gauge Some Narrow	53	—	14.3	1907	Janesville, Wis.	C.M.H.W.	Gravel	Good	90	Cut	Milwaukee	Light	1915	8.5	0	—	66 ft. Gauge	—	38% Partly decayed	26.00
2.1	CREOSOTE - SEELEY	—	—	—	25000	—	—	1869	—	C.B.&Q.	—	—	—	—	—	—	1908	—	—	—	—	5-12	Painters - Dry rot	1.30
4.1	MERCURIC CHLORIDE - KYAN	—	—	—	100,000	—	—	1884	—	C.P.R.	—	—	—	—	—	—	1908	—	—	—	—	10-15	Splintered	1.00
5.1	SALTS (BARSCHALL HASSELMANN)	—	—	—	100	—	—	1902	Shawnee, Okla.	A.C.Y.S.R.	Sand	—	60	Cut	None	—	1910	6	100	—	—	3.25	Top 1/8 replaced by Road Service 3½ out in 1908	11.00
6.1	UNTREATED	—	—	—	85	—	—	1909	Lewis East	C.B.&Q.	Broken Gravel Burnt Clay	—	90-95	—	Partly	—	1914	5	814	—	—	—	—	5.00
6.2	—	—	—	—	25	—	—	1910	〃	〃	Gravel	—	90	—	All	—	〃	4	78	—	—	—	D.S.S. damaged but not removed	〃
6.3	—	—	—	—	47	—	—	1909	Lewis West	〃	Broken Gravel Burnt Clay	—	90-95	—	Yes	—	〃	5	78.2	—	—	—	—	〃
6.4	—	—	—	—	30	—	—	1910	〃	〃	Lyons Stone	—	90	—	—	—	〃	4	15	—	—	—	—	〃
3.00	Cedar	Indian Nos.	1.5 and 1.6																				
6.5	—	—	—	—	101	—	—	1902	Shawnee, Okla.	A.C.Y.S.R.	Sand	Poor	60	Cut	None	Heavy	1909	2	100	—	—	—	—	11.00
6.6	6'-8"-8'	Same as Above	Standard Gauge	—	20	—	—	1907	Janesville, Wis.	C.M.H.W.	〃	〃	90	〃	〃	Light	1915	8.5	90	Heavy	Partly Decayed	65	—	26.00
6.7	〃	〃 〃	Notched Standard Gauge	—	20	—	—	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	100	〃	—	6.8	—	〃
6.8	〃	Not Hewn	〃	25½	20	—	—	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	100	〃	—	6.6	—	〃
6.9	〃	Slabs	〃	25½	20	—	—	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	100	〃	—	6.6	—	〃
6.10	〃	Flat	〃	25½	20	—	—	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	100	〃	—	6.85	—	〃
6.11	〃	Slab	〃	35½	20	—	—	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	95	〃	Partly Decayed	6.3	—	〃
6.12	〃	〃 〃	Standard Gauge	35½	30	—	—	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	90	〃	〃	7.14	—	〃
7.1	ZINC CHLORIDE - BURNETT	—	—	—	70.	—	0.5	1907	Lewis East	C.B.&Q.	Broken Gravel Burnt Clay	—	90-95	—	Partly	—	1914	5	14	—	—	—	—	5.00
7.2	—	—	—	—	56	—	〃	1910	〃	〃	Gravel	—	90	—	All	—	〃	4	0	—	—	—	—	〃
7.3	—	—	—	—	43	—	〃	1909	Lewis West	〃	Broken Gravel Burnt Clay	—	85-90	—	Yes	—	〃	5	0	—	—	—	—	〃
7.4	—	—	—	—	45	—	〃	1910	〃	〃	Lyons Stone	Very Dry	90	—	〃	—	〃	4	0	—	—	—	—	〃
7.5	—	—	—	—	—	—	—	1845	Vermont	Vt. Central	—	—	—	—	—	—	1892	26	—	—	Sound	—	Found on old siding not in use for 20 years	2.40
7.6	—	—	—	—	11398	—	—	1896	Lewis West	Ft. Scott	—	—	—	—	—	—	1905	8	22	—	—	—	—	1.30
7.7	—	—	—	—	713	—	—	1898	〃	〃	—	—	—	—	—	—	〃	7	0	—	—	—	—	1.30

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
7.8	—	—	—	2048	—	—	1899	Western Lines	Pa. System	—	—	—	—	—	—	1905	6	0	—	—	—		1.30
7.9	—	—	—	521	—	—	1900	—	—	—	—	—	—	—	—	do	5	0	—	—	—		do
7.10	—	—	—	698	—	—	1896	Chicago, Ill.	Pa. System	—	—	—	—	—	—	do	9	0	—	—	—		do
7.11	—	—	—	3499	—	—	1897	—	do	—	—	—	—	—	—	do	8	30	—	—	—		do
7.12	—	—	—	275	—	—	1898	do	—	—	—	—	—	—	—	do	7	0	—	—	—		do
7.13	—	—	—	1000	—	—	1899	—	do	—	—	—	—	—	—	do	6	0	—	—	—		do
7.14	—	—	—	5934	—	0.22	1888	Evansten Ill.	B+N.W.	—	—	—	—	—	—	1906	18	—	—	—	—		do
7.15	—	—	—	100	—	0.62	1902	Beaumont, Tex.	G.C.+S.F.	Sand	Poor	60	Cut	None	Heavy	1912	10	30	—	—	—	Started to fail 1908 46% more decayed	11.00
7.16	—	—	—	2,184,536	—	0.50	1903	—	C.T.H.W.	—	—	—	—	—	—	1908	5	—	—	—	—		1.00
7.17	6"x8"x8'	Hewn	Treated and seasoned Butts	25	—	0.26	1907	Janesville, Wis	do	Gravel	Good	90	Cut	Helicopter	Light	1914	7.6	16.0	Decay	60% Dead	—		26.00
7.18	—	—	Seasoned	8	—	—	1909	Tacoma, Ill.	C.B.+Q.	—	—	—	—	—	—	do	3	0	—	—	—		5.00
7.19	—	—	—	2000	—	—	1866	Chicago, Ill.	C.R.I.+P.	Fine Gravel	—	—	Cut	—	Heavy	1881	15	25	—	Fair	—	Some decay at top - sides and center solid	2.40
7.20	—	—	—	—	—	—	1867-8	Mouth Chunk	C.R.R. of N.J.	Stone	—	—	—	—	—	1883	16-17	—	—	Good		Rail worn 5/8"	do
	ZINC CREOSOTE - ALLARDYCE																						
8.1	—	—	—	50	—	0.20 Zinc 0.80 Creo.	1902	Beaumont Tex.	G.C.+S.F.	Sand	Poor	60	Cut	None	Heavy	1911	9	100	—	—	9	Avg. 1.7% estimated by Forest Service	11.00
	ZINC CREOSOTE - CARD																						
9.1	—	—	—	511	—	0.5 Zinc 0.5 Creo	1909	Lines East	C.B.+Q.	Cinders Gravel Burnt Clay	—	75-85 90	—	Partly	—	1914	5	0	—	—	—	1% split	5.00
9.2	—	—	—	298	—	do	1910	do	do	Gravel	—	90	—	All	—	do	4	0	—	—	—		do
9.3	—	—	—	277	—	do	1909	Lines West	do	Cinders Gravel Burnt Clay	—	75-85 90	—	Yes	—	do	5	0	—	—	—		do
9.4	—	—	—	210	—	do	1910	do	do	Lyons Stone	Very Dry	90	—	do	—	do	4	0	—	—	—		do
9.5	—	—	—	49	—	0.3 Zinc	1902	Beaumont, Tex.	G.C.+S.F.	Sand	Poor	60	Cut	None	Heavy	1912	10	88	—	—	5	Avg. life estimated by Forest Service	11.00
9.6	4"x8"x8'	Hewn	Seasoned	107	—	0.5 Zinc 0.5 Creo.	1911	Bardwell, Wis.	C.M.+St.P.	Gravel	Good	75	3% Curve	As Mallerable	Average Heavy	1915	4	0	—	Good	—	Includes Hemlock	6.00
9.7	6"x8"x8'	do	do	1000	—	do	1910	Idaline, Ill	do	do	do	100	—	do	do	do	5	0	—	—	—		do
	ZINC AND CRUDE OIL																						
10.1	—	—	—	3	—	—	1911	Baders, Ill.	C.B.+Q.	Gravel	—	75	—	Except under joints	—	1912	1	0	—	—	—		5.00
	ZINC TANNIN - WELLHOUSE																						
11.1	—	—	—	1287	—	—	1897	—	S.C.+S.R.R.	—	—	—	—	—	—	1905	8	30	—	—	—		1.30
11.2	—	—	—	200	—	—	1892	Hanna	Pa System	Rock	—	—	—	—	—	do	13	100	—	—	10.71		29.40
11.3	—	—	—	21850	—	—	1886	W. Ha. River	C.R.I.+P.	Various	—	—	—	—	—	1898	12	63.1	Various	—	11.8		2.00
11.4	—	—	—	200	—	—	1891	P. Maburg Pa.	Pa System	—	—	—	—	—	—	do	7	0	—	—	—		do
11.5	—	—	—	72194	—	—	1886-91	Illinois	C.R.I.+P.	Poor	Poor	—	—	—	—	do	7-12	70	—	—	—	Includes Tamarack	do
11.6	—	—	—	5641731	—	0.50	1886	—	do	—	—	—	—	—	—	1908	—	—	Decay Rail Cut	—	11	do	1.00
11.7	—	—	—	150,000	—	0.30	do	—	U.P.	—	—	—	—	—	—	do	—	—	Rail Worn	—	12-15	do	do
11.8	—	—	—	100	—	0.54	1902	Beaumont, Tex.	G.C.+S.F.	—	—	—	—	—	—	1911	8	21	—	—	—	Replacement began in 1909	11.00
11.9	6"x8"x8'	Hewn	Treated & Seasoned 17 Mo	55	—	0.532	1907	Janesville, Wis	C.T.H.W.	Gravel	Good	90	Screw	Flat Sellers	Light	1915	7.5	3.6	—	—	—	11.1% Partly decayed	26.00
11.10	do	do	do 16.5 Mo	40	—	0.564	do	do	do	do	do	do	do	do	do	do	do	0	—	—	—	7.5% do	do
11.11	do	do	do 16 Mo	41	—	0.408	do	do	do	do	do	do	do	do	do	do	do	0	—	—	—	9.8% do	do
11.12	do	do	do 15 Mo	40	—	0.464	do	do	do	do	do	do	do	do	do	do	do	0	—	—	—	7.5% do	do
11.13	do	do	do 14 Mo	40	—	0.428	do	do	do	do	do	do	do	do	do	do	do	0	—	—	—	19.9% do	do
11.14	do	do	do 12 Mo	37	—	0.376	do	do	do	do	do	do	do	do	do	do	do	0	—	—	—	21.9% do	do
11.15	do	do	do 11 Mo	41	—	0.340	do	do	do	do	do	do	do	do	do	do	do	9.8	—	—	—	10.0% do	do
11.16	do	do	do 11 Mo	40	—	0.384	do	do	do	do	do	do	do	do	do	do	do	0	—	—	—	8.5% do	do
11.17	do	do	Standard Seasoned 13 Mo	24	—	0.728	do	do	do	do	do	do	do	do	do	do	do	0	—	—	—	4.0% do	do
11.18	do	do	do 16 Mo	25	—	0.60	do	do	do	do	do	do	do	do	do	do	do	2.5	—	—	—	5.0% do	do
11.19	do	do	do 12 Mo	40	—	0.592	do	do	do	do	do	do	do	do	do	do	do	0	—	—	—	12.8% do	do
11.20	do	do	Stacked 9 Seasoned Peeled 8 Seasoned 17 Mo	47	—	0.516	do	do	do	do	do	do	do	do	do	do	do	2.5	—	—	—		do
11.21	do	do	do	40	—	0.468	do	do	do	do	do	do	do	do	do	do	do	0	—	—	—	12.5% Partly decayed	do
11.22	do	do	do 16.5 Mo	40	—	0.564	do	do	do	do	do	do	do	do	do	do	do	0	—	—	—	15.0% do	do
11.23	do	do	do 16 Mo	40	—	0.428	do	do	do	do	do	do	do	do	do	do	do	0	—	—	—	7.5% do	do

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1	2	3	4a	5c	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
M.34	6"×8"×8'	Hewn	Adz'd Hewed 16 M.	40	—	0.512	1907	Chemung, Ills	C.P.M.W.	Gravel	Good	90	Cut	Sandy	Light	19.5	7.5	0	—	Good	—	5.3%	Partly decayed	26.00
M.35	〃	〃	〃 〃 14 M.	40	—	0.448	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	10.0%	〃	〃
M.36	〃	〃	〃 〃 12 M.	40	—	0.352	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	5.0%	〃	〃
M.37	〃	〃	〃 〃 14 M.	40	—	0.352	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	10.0%	〃	〃
M.38	〃	〃	〃 〃 12 M.	39	—	0.448	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	2.5%	〃	〃
M.39	〃	〃	Hewed Adz'd Hewed 17 M.	25	—	0.708	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	4.0%	〃	〃
M.30	〃	〃	〃 〃 14 M.	25	—	0.504	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—			〃
M.31	〃	〃	〃 〃 10 M.	40	—	0.512	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	7.5%	Partly decayed	〃
M.32	〃	〃	Scribed & Hewed 16 M.	44	—	0.496	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	2.0	—	〃	—	16.0%	〃	〃
M.33	〃	〃	Scribed & Hewed 17 M.	39	—	0.516	〃	〃	〃	〃	〃	〃	〃	〃	Yellow Pine	〃	〃	〃	—	〃	—	17.9%	〃	〃
M.34	〃	〃	〃 16 M.	41	—	0.556	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	4.4%	〃	〃
M.35	〃	〃	〃 15 M.	45	—	0.452	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—			〃
M.36	〃	〃	〃 14 M.	39	—	0.448	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	35.0%	Partly decayed	〃
M.37	〃	〃	〃 13 M.	40	—	0.388	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	5.0%	〃	〃
M.38	〃	〃	〃 12 M.	40	—	0.376	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	2.5	—	〃	—	17.5%	〃	〃
M.39	〃	〃	〃 11 M.	40	—	0.428	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	2.5	—	〃	—	2.5%	〃	〃
M.40	〃	〃	〃 10 M.	40	—	0.388	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	17.5%	〃	〃
M.41	〃	〃	Hewed Adz'd Hewed 16 M.	25	—	0.564	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	32.0%	〃	〃
M.42	〃	〃	〃 13 M.	21	—	0.484	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	4.8%	〃	〃
M.43	〃	〃	〃 10 M.	40	—	0.548	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	2.5%	〃	〃
M.44	〃	〃	Hewed & Scribed Trimmed 15 M.	49	—	0.580	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	8.2%	〃	〃
M.45	〃	〃	Undercut Hewed Trimmed 18 M.	53	—	0.356	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	26.5%	〃	〃
M.46	〃	〃	〃	57	—	0.356	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	39.2%	〃	〃
M.47	〃	〃	〃	51	—	0.496	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	—	〃	—	17.6%	〃	〃

HEMLOCK - WESTERN

	UNTREATED																							
12.1	7'3"×8"	Hewn	Green	100	—	—	1907	Haywood, Wash	N.P.	Gravel	Good	85	Cut	Flat Piles	Heavy	19.5	8.5	100	Decay	Poor	9.30			25.00
12.2	〃	Sawn	〃	103	—	—	1906	〃	〃	〃	〃	85	〃	Poles	〃	〃	8.5	100	—	—	9.30			〃

TABLE 13 HICKORY - PIGNUT

	CREOSOTE - FULL CELL																							
L.1	—	—	—	4	—	—	1910	Blanding, Ind.	C.B.&Q.	Shale & Gravel	—	90	—	All	—	1912	2	0	—	—	—			6.00
L.2	—	—	Seasoned 1st. after treatment	14	—	—	〃	Barr, Colo.	〃	Lyons Shale	Very Dry	〃	—	〃	—	〃	2	0	—	—	—			〃
L.3	—	—	—	6	—	—	〃	Hanover, Ill.	〃	Shale & Gravel	—	〃	—	〃	—	〃	2	0	—	—	—			〃
	UNTREATED																							
P.1	—	—	—	65	—	—	1909	Lima East	〃	Clayton Gravel & Sand Clay	—	85-95 per cent	—	Partly	—	1914	5	53.8	—	—	—			〃
P.2	—	—	—	30	—	—	〃	〃 West	〃	〃	—	〃	—	All	—	〃	5	72.0	—	—	—			〃
P.3	—	—	—	9	—	—	1910	〃 East	〃	Gravel	—	90	—	〃	—	〃	4	44.0	—	—	—			〃
P.4	—	—	—	15	—	—	〃	〃 West	〃	Lyons Shale	—	〃	—	〃	—	〃	4	0	—	—	—	9 split - 6 fully rotten and split		〃
	ZINC CHLORIDE - BURNETT																							
Z.1	—	—	—	4	—	0.5	1910	Blanding, Ill	〃	Gravel	—	90	—	All	—	1912	2	0	—	—	—			〃
Z.2	—	—	Seasoned 1yr. after treatment	15	—	〃	〃	Barr, Colo	〃	Lyons Shale	Very Dry	〃	—	〃	—	〃	2	0	—	—	—			〃
Z.3	—	—	—	5	—	〃	〃	Hanover, Ill.	〃	Gravel	—	〃	—	〃	—	〃	2	0	—	—	—			〃

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	ZINC CREOSOTE - CARD																						
4.1	—	—	—	164	—	0.5 zinc 2.0 Creo	1909	Lines East	C.B.&Q	Cinders, Gravel Gravel Clay	—	75-85 90	—	Partly	—	1914	5	1.0	4	—	—	—	5.00
4.2	—	—	—	89	—	4	4	4 West	4	4	—	85-90	—	All	—	4	5	0	—	—	—	—	4
4.3	—	—	—	20	—	4	1910	4 East	4	Gravel	—	90	—	4	—	4	4	0	—	—	—	—	4
4.4	—	—	—	16	—	4	4	4 West	4	Lyons Shale	Very Dry	90	—	4	—	4	4	0	—	—	7	—	4
										TABLE 14 JUNIPER													
	CREOSOTE - FULL CELL																						
@1.1	—	Brown	Seasoned 10 lbs. Acid 3 lbs. after Treatment	25	—	8	1897	Norfolk to Dix.	N.P.S.	—	—	—	—	One half Treated	—	1916	15	44	—	—	17	Started to fail in 1900 - 2nd Course - After that Broken every 4th Tie	16.00
1.2	—	4	4	75	—	8	4	4	4	—	—	—	—	4	—	4	15	4	—	—	—	Started to fail in 1911	4
	UNTREATED																						
@2.1	—	Brown	Seasoned 13.1%	30	—	—	1897	Norfolk to Dix.	N.P.S.	—	—	—	—	—	—	1916	—	100	—	—	8.0	Started to fail 1901 All out 1908	16.00
@2.2	—	4	Seasoned 14.1%	100	—	—	4	4	4	—	—	—	—	Part	—	4	15	67	—	—	18.9	4 1908	4
@2.3	—	4	4	100	—	—	4	4	4	—	—	—	—	Lapwelps	—	4	15	70	—	—	15.2	4 1908	4
@2.4	—	4	4	100	—	—	4	4	4	—	—	—	—	—	—	4	15	77	—	—	13.9	4 1905 Ties covered Ballast and last Shoulder & Ditch	4
@2.5	—	4	4	100	—	—	4	4	4	—	—	—	Gobb	—	—	4	15	75	—	—	13.0	Started to fail 1907 & entire line out last Shoulder & Ditch	4
@2.6	—	4	4	100	—	—	4	4	4	—	—	—	—	—	—	4	15	73	—	—	13.2	Started to fail 1905 Ballast & Spotting of Cinders	4
@2.7	—	4	4	130	—	—	4	4	4	—	—	—	—	—	—	4	15	79	—	—	14.0	Started to fail 1907 - Ballast & Grade of Cinders & Sand	4
@2.8	—	4	4	100	—	—	4	4	4	—	—	—	—	—	—	4	15	62	—	—	14.6	Started to fail 1905	4
@2.9	—	4	4	135	—	—	4	4	4	—	—	—	—	Sawns	—	4	18	100	—	—	11.3	4 1905 Ahead 1919	4
@2.10	—	4	4	200	—	—	4	4	4	—	—	—	—	—	—	4	15	81	—	—	12.2	4 1911	4
										LARCH													
	ZINC CHLORIDE - IMPREGNATED																						
3.1	—	—	—	—	—	—	—	Sioux Naval Coal Docks	—	—	—	—	—	—	—	—	—	—	—	—	15.17	—	2.00
										LARCH - WESTERN													
	UNTREATED																						
4.1	7"@7'8"	—	Seasoned	27	—	—	1907	Minot, Mont.	N.P.	Gravel	Excellent	85	Some Cinders	Northern Washington	—	1915	8.33	100	—	—	6.89	—	25.00
4.2	4	—	Green	96	—	—	4	4	4	4	4	4	4	4	—	4	4	100	—	—	6.89	—	4
4.3	4	—	Seasoned	90	—	—	4	4	4	4	4	4	Cut	Washington	—	4	4	100	—	—	7.15	—	4
4.4	4	—	Green	91	—	—	4	4	4	4	4	4	4	4	—	4	4	100	—	—	7.15	—	4
4.5	4	—	Seasoned	90	—	—	4	4	4	4	4	4	4	Sahms	—	4	4	100	—	—	7.55	—	4
4.6	4	—	Green	90	—	—	4	4	4	4	4	4	4	4	—	4	4	100	—	—	7.53	—	4
4.7	4	—	Seasoned	90	—	—	4	4	4	4	4	4	4	4	—	4	4	100	—	—	7.53	—	4
4.8	4	—	Green	91	—	—	4	4	4	4	4	4	4	4	—	4	4	100	—	—	7.35	—	4
4.9	4	—	Seasoned	90	—	—	4	4	4	4	4	4	Some Cut	4	—	4	4	98.9	—	—	7.42	—	4
4.10	4	—	Green	91	—	—	4	4	4	4	4	4	4	4	—	4	4	100	—	—	7.35	—	4
4.11	4	—	Seasoned	90	—	—	4	4	4	4	4	4	Some	4	—	4	4	98.9	—	—	7.78	—	4
4.12	4	—	Green	92	—	—	4	4	4	4	4	4	4	4	—	4	4	98.9	—	—	7.78	—	4
4.13	4	—	Seasoned	91	—	—	4	4	4	4	4	4	Cut	N.P.N.P.	—	4	4	100	—	—	7.39	—	4

@ Average 1.6 estimated by Forest Service

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TABLE 15 - MAPLE

	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1	ZINC CHLORIDE - BURNETT																						
S1	9'-0"-8"	None	Seasoned	101	—	0.786	1907	Mass. Road	H.P.	Gravel	Perfect	85	Screw	Bolted	None	1914	93	0	1	—	—	Perfect condition	25.00
S2	〃	〃	〃	98	—	〃	〃	〃	〃	〃	〃	〃	Spike	〃	〃	〃	〃	27	—	—	—	〃	〃
										TABLE 15 - MAPLE													
	CREOSOTE FULL CELL																						
⊕1.1	6'-8"-8"	—	Seasoned 6-18 Hrs	50	—	12	1911	Hartford Mass	CHASP	Gravel	Good	90	Screw	Flat	Heavy	1914	3	0	—	—	—	14% Partly Split	27.00
01.2	〃	—	〃	50	—	〃	〃	〃	〃	〃	〃	〃	Cut	None	〃	〃	3	0	—	—	—	14% 〃	〃
	CREOSOTE - RUFFING																						
⊕2.1	6'-8"-8"	—	Seasoned 6-18 Hrs	50	—	49	〃	〃	〃	〃	〃	〃	Screw	Flat	〃	〃	3	0	—	—	—	15% Partly Split	〃
⊕2.2	〃	—	〃	50	—	〃	〃	〃	〃	〃	〃	〃	Cut	None	〃	〃	3	0	—	—	—	15% 〃	〃
	CRESOL - CALCIUM																						
See ELM Index No 6.1																							
	OIL SEMI-REFINED - FULL CELL																						
⊕3.1	6'-8"-8"	—	Seasoned 6-18 Hrs	50	—	12.6	1911	Hartford Mass	CHASP	Gravel	Good	90	Screw	Flat	Heavy	1914	3	0	—	—	—	8 & 13% Partly Split	27.00
⊕3.2	〃	—	〃	50	—	12.6	〃	〃	〃	〃	〃	〃	Cut	None	〃	〃	3	0	—	—	—	〃	〃
⊕3.3	〃	—	〃	50	—	0.5	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	3	0	—	—	—	〃	〃
⊕3.4	〃	—	〃	50	—	0.5	〃	〃	〃	〃	〃	〃	Screw	Flat	〃	〃	3	0	—	—	—	〃	〃
3.5	〃	—	〃	50	—	—	1907	Neck Church	CRR Steel	Rock	—	—	—	—	—	1893	16-17	—	—	Good	—	—	8.40
	UNTREATED																						
4.1	6'-8"-8"	—	Not Seasoned	50	—	—	1911	Hartford Mass	CHASP	Gravel	Good	90	Screw	Flat	Heavy	1914	3	0	—	—	—	92% Partially decayed	27.00
4.2	〃	—	〃	50	—	—	〃	〃	〃	〃	〃	〃	Cut	None	〃	〃	3	0	—	—	—	〃	〃
	ZINC CREOSOTE - CARD																						
S1	9'-9"-9"	—	—	596	—	—	1908	Dedham Mass	〃	Sand Clay	—	85	—	None	—	1914	6	0	—	—	—	2° Curve - Load in end	8.00
⊕S2	〃	—	Seasoned 6-18 Hrs	50	—	0.5 Lbs per cu ft	1911	Hartford Mass	〃	Gravel	Good	90	Screw	Flat	Heavy	〃	3	0	—	—	—	16% Partly Split	27.00
⊕S3	〃	—	〃	50	—	〃	〃	〃	〃	〃	〃	90	Cut	None	〃	〃	3	0	—	—	—	〃	〃
	ZINC CREOSOTE - TWO MOVEMENT																						
6.1	6'-8"-8"	—	Seasoned 6-18 Hrs	50	—	—	〃	〃	〃	〃	〃	〃	Screw	Flat	〃	〃	3	0	—	—	—	2% Partly charred 8% partly split	〃
6.2	〃	—	〃	50	—	—	〃	〃	〃	〃	〃	〃	Cut	None	〃	〃	3	0	—	—	—	〃	〃
	ZINC TANNIN - WELL HOUSE																						
See ASH Index No 6.1																							

⊕ - Max Pressure 175 lbs per Sq In - Max Temperature 180°F. Time 8.5 Hours. Final Vacuum 28 inch Time 15 Minutes.
⊕ - Prelim Pressure 90 lbs per Sq In for 30 Min - Max Pressure 140 lbs per Sq In at 180°F for 3.83 Hours - Final Vacuum 28 inch for 15 Minutes
⊕ - Max Pressure 175 lbs per Sq In at 180°F for 3.6 Hours - Final Vacuum 20 inch for 15 Minutes
⊕ - Prelim Vacuum 26 for 30 Minutes - Max Pressure 200 lbs per Sq In. at 160°F for 3.14 Hours
⊕ - Prelim Vacuum 26 inch for 1 Hour - Max Pressure 175 lbs per Sq In at 190°F for 4.0 Hours. - Final Vacuum 26 inch for 30 Minutes

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1.1	—	—	—	30	—	S.92	1909	Lows East	C.B.T.Q.	Ogden Gravel Bent Clay	—	20-25	—	Partly	—	1914	5	0	—	—	—		5.00
1.2	—	—	—	18	—	do	do	do West	do	do	—	25-30	—	Yes	—	do	5	0	—	—	—		do
1.3	—	—	—	60	—	do	1910	do East	do	Gravel	—	20	—	All	—	do	4	0	—	—	—		do
1.4	—	—	—	15	—	do	do	do West	do	Lyons Stone	Very Dry	20	—	Yes	—	do	4	0	—	—	—		do
1.5	—	—	—	15	—	do	1911	do East	do	Gravel	—	25	—	Essex Land	—	do	3	0	—	—	—		do
	UNTREATED																							
2.1	—	—	—	51	—	—	1909	do East	do	Ogden Gravel Bent Clay	—	20-25	—	Partly	—	do	5	140	—	—	—		do
2.2	—	—	—	39	—	do	do	do West	do	do	—	25-30	—	Yes	—	do	5	46.6	—	—	—		do
2.3	—	—	—	24	—	—	1910	do East	do	Gravel	—	20	—	All	—	do	4	80.0	—	—	—		do
2.4	—	—	—	15	—	—	do	do East	do	Lyons Stone	Very Dry	20	—	Yes	—	do	4	110.0	—	—	—		do
	ZINC CHLORIDE - BURNETT																							
3.1	—	—	—	20	—	0.5	1910	Hanover, Ill.	do	Sanders Gravel	—	20	—	All	—	1912	2	0	—	—	—	7% split	do
3.2	—	—	—	40	—	do	do	Bradley, Ill.	do	do	—	20	—	do	—	do	2	0	—	—	—		do
3.3	—	—	Removed Apr 20th Treatment	15	—	do	do	Barr, Colo.	do	Lyons Stone	Very Dry	20	—	Yes	—	do	2	0	—	—	—		do
	ZINC CREOSOTE - CARD																							
4.1	—	—	—	396	—	25 Zinc to Creo	1909	Lows East	do	Ogden Gravel Bent Clay	—	20-25	—	Partly	—	1914	5	2.5	—	—	—		do
4.2	—	—	—	207	—	do	do	do West	do	do	—	25-30	—	Yes	—	do	5	0	—	—	—		do
4.3	—	—	—	175	—	do	1910	do East	do	Gravel	—	20	—	All	—	do	4	0	—	—	—		do
4.4	—	—	—	65	—	do	do	do West	do	Lyons Stone	—	20	—	Yes	—	do	4	0	—	—	—		do
4.5	—	—	—	540	—	do	1911	Waco, Neb.	do	Bent Clay	Good	25	—	do	Plenty	do	3	0	—	—	—	In perfect Condition	do
4.6	7-9-9	Sawed	Seasoned 6 Mo.	576	—	25 Zinc to Creo	1908	Grayson, Ne.	C.B.T.Q.	Bent Gumbo	Fair	25	Cut	None	Heavy	1915	7	0	—	Good	—	5 Cores - appear to be good for 4-7,500 more	6.00
	TABLE 17 MAPLE SOFT																							
	CREOSOTE - FULL CELL																							
1.1	—	—	—	28	—	12.80	1909	Lows East	C.B.T.Q.	Ogden Gravel Bent Clay	—	20-25	—	Partly	—	1914	5	0	—	—	—		5.00
1.2	—	—	—	48	—	do	do	do West	do	do	—	25-30	—	All	—	do	5	0	—	—	—		do
1.3	—	—	—	59	—	do	1910	do East	do	Gravel	—	20	—	do	—	do	4	0	—	—	—		do
1.4	—	—	—	15	—	do	do	do West	do	Lyons Stone	—	20	—	do	—	do	4	0	—	—	—		do
	CRUDE OIL																							
2.1	—	—	—	4	—	—	1911	Bradley, Ill.	do	Gravel	—	25	—	Ill. Creo. Coal Tar	—	do	3	0	—	—	—		do
	UNTREATED																							
3.1	—	—	—	57	—	—	1909	Lows East	do	Ogden Gravel Bent Clay	—	20-25	—	Partly	—	do	5	17.0	—	—	—		do
3.2	—	—	—	28	—	—	do	do West	do	do	—	25	—	All	—	do	5	9.3.0	—	—	—		do
3.3	—	—	—	25	—	—	1910	do East	do	Gravel	—	20	—	do	—	do	4	76.0	—	—	—		do
3.4	—	—	—	14	—	—	do	do West	do	Lyons Stone	—	20	—	do	—	do	4	100.	—	—	—		do
	ZINC CHLORIDE - BURNETT																							
4.1	—	—	—	75	—	0.5	1909	do East	do	Ogden Gravel Bent Clay	—	20-25	—	Partly	—	do	5	3	Split	—	—		do
4.2	—	—	—	61	—	do	do	do West	do	Ogden Gravel Bent Clay	—	25-30	—	All	—	do	5	2.	Not	—	—	14% split	do
4.3	—	—	—	50	—	do	1910	do East	do	Gravel	—	20	—	do	—	do	4	0	—	—	—	2% Decayed	do
4.4	—	—	—	15	—	do	do	do West	do	Lyons Stone	—	20	—	do	—	do	4	0	—	—	—		do
	ZINC CREOSOTE - CARD																							
5.1	—	—	—	385	—	25 Zinc to Creo	1909	do East	do	Ogden Gravel Bent Clay	—	20-25	—	Partly	—	do	5	0	—	—	—	21% split	do
5.2	—	—	—	202	—	do	do	do West	do	do	—	25-30	—	All	—	do	5	0	—	—	—	4% split 11% Burned	do
5.3	—	—	—	75	—	do	1910	do East	do	Gravel	—	20	—	do	—	do	4	0	—	—	—	3% Decayed	do
5.4	—	—	—	61	—	do	do	do West	do	Lyons Stone	—	20	—	do	—	do	4	0	—	—	—	—	do

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
TREATED - PROCESS NOT KNOWN																							
11	—	—	—	40885	—	—	1904	Illinois	C.B.&Q.	—	—	—	—	—	—	1910	6	4.3	—	—	—	—	1.10
UNTREATED																							
⑦10.1	—	—	—	25	—	—	1912	Desmond Tr.	G.T.&S.F.	Sand	Poor	60	Cut	None	Heavy	1908	6	10.0	—	—	4.6	Started to fail 1905 30% out by 1907	1.00
ZINC CHLORIDE - BURNETT																							
⑧11.1	—	—	—	34	—	0.35	do	do	do	do	do	do	do	do	do	1911	9	10.0	—	—	2.0	Started to fail in 1908	do
ZINC CREOSOTE																							
⑦12.1	—	—	—	76	—	—	do	do	do	do	do	do	do	do	do	1904	2	10.0	—	—	4.84	do 1913	do
ZINC CREOSOTE - ALLAROYCE																							
13.1	—	—	—	60	—	0.20 Zinc 0.80 Creo.	do	do	do	do	do	do	do	do	do	1912	10	7.7	—	—	—	do 1911	do
ZINC TANNIN - WELLHOUSE																							
14.1	—	—	—	86	—	0.33	do	do	do	do	do	do	do	do	do	do	10	2.8	—	—	—	do 1908	do
14.2	—	—	—	33	—	0.33	do	do	do	do	do	do	do	do	do	do	10	8.8	—	—	—	do 1908	do
⑤14.3	—	—	—	111,816	—	—	1899	—	C.P.R.R.	—	—	—	—	—	—	1910	11	12.6	All Decays	—	—	—	2.00
⑧14.4	—	—	—	221,568	—	—	1900	—	do	—	—	—	—	—	—	do	10	5.1	do	—	—	—	do
⑧14.5	—	—	—	172,477	—	—	1901	—	do	—	—	—	—	—	—	do	9	2.6	do	—	—	—	do
⑧14.6	—	—	—	124,430	—	—	1902	—	do	—	—	—	—	—	—	do	8	0.9	do	—	—	—	do
⑧14.7	—	—	—	92,317	—	—	1903	—	do	—	—	—	—	—	—	do	7	0.6	do	—	—	—	do
⑧14.8	—	—	—	181,426	—	—	1904	—	do	—	—	—	—	—	—	do	6	1.0	do	—	—	—	do
⑧14.9	—	—	—	362,409	—	—	1905	—	do	—	—	—	—	—	—	do	5	0.3	do	—	—	—	do
⑧14.10	—	—	—	448,113	—	—	1906	—	do	—	—	—	—	—	—	do	4	0.1	do	—	—	—	do
⑧14.11	—	—	—	146,329	—	—	1907	—	do	—	—	—	—	—	—	do	3	0.1	do	—	—	—	do
OAK - CHESTNUT																							
UNTREATED																							
15.1	—	—	Steamed 6 hrs	424	—	—	1904	Hudson Bad.	B.&O.S.W.	—	—	—	—	—	—	1909	5	15	—	—	—	33⅓% removals for 1910 9⅓% out 1910 66⅔% out 11.5	4.00
WOOD TAR CREOSOTE - DIPPED 1 HOUR																							
18.1	—	—	—	1	—	—	1894	Altoona Pa.	Pa. System	—	—	—	—	—	—	1914	—	—	Decay	—	1.3	—	20.10
OAK - DANISH																							
UNTREATED																							
17.1	45°-9°	—	—	3500	—	—	1898	Denmark	Hillbroad	—	—	—	—	—	—	1912	11	15	—	—	—	—	9.00
OAK - MIXED																							
CREOSOTE																							
18.1	7-8"x 8.5'	—	—	3850	30-40	—	1910	Wooster, Ohio	Pa System	—	—	—	—	—	—	1915	5	—	—	—	—	No decay - some cutting by R.R.'s and plates	20.00
TABLE 19 OAK-PIN																							
CREOSOTE - FULL CELL																							
1.1	—	—	—	164	—	6.17	1909	Lines East	C.B.&Q.	Sandy Gravel Some Clay	—	20-25	—	Partly	—	1914	5	0	—	—	—	—	5.00
1.2	—	—	—	24	—	do	1910	do do	do	Gravel	—	30	—	All	—	do	4	0	—	—	—	—	do
1.3	—	—	—	3	—	do	1911	do do	do	do	—	25	—	Except under rails	—	do	3	0	—	—	—	—	do
1.4	—	—	—	87	—	do	1909	do West	do	Sandy Gravel Some Clay	—	20-30	—	Yes	—	do	5	0	—	—	—	—	do
1.5	—	—	—	45	—	do	1910	do do	do	Lyons Shale	Very Dry	90	—	do	—	do	4	0	—	—	—	—	do
UNTREATED																							
2.1	—	—	—	54	—	—	1909	Lines East	C.B.&Q.	Sandy Gravel Some Clay	—	25-30	—	Partly	—	1914	5	52.2	—	—	—	—	5.00
2.2	—	—	—	30	—	—	do	do West	do	do	—	do	—	Yes	—	do	5	46.7	—	—	—	—	do
2.3	—	—	—	24	—	—	1910	do East	do	Gravel	—	20	—	Full	—	do	4	0	—	—	—	—	do
2.4	—	—	—	15	—	—	do	do West	do	Lyons Shale	Very Dry	25-30	—	Yes	—	do	4	0	—	—	—	—	do

1. Average life as estimated by Forest Service.

X1	[illegible]	—	—	10	—	—	1908	Miss. [illegible]	[illegible]	—	—	—	—	—	1914	—	60	60 lbs cu ft	—		Ground not complete	20.10
	5.4% CHLORIDE SUBMERGED																					
A1	—	—	—	15	—	8.5	1910	Hanover, N.H.	C.B.&P.	Sandy Gravel	—	90	—	All	—	1918	2	0	—	—	—		5.00
A2	—	—	—	9	—	8.5	do	Hinckley, Ill.	do	do	—	90	—	10's	—	do	2	0	—	—	—		do
A3	—	—	Dressed & Sat. Treated	45	—	do	do	Kent, Ohio	do	Cypress Stone	—	90	—	do	—	do	2	0	—	—	—		do
	ZINC CREOSOTE - CAP'D																					
S1	—	—	—	985	—	8.5 Zinc 6.6 Creo	1909	Lines East	do	Ballast Gravel Slag &c.	—	90-95	—	Partly	—	1914	5	0	—	—	—		do
S2	—	—	—	201	—	do	do	do West	do	do	—	90-95	—	All	—	do	5	0	—	—	—	1% split	do
S3	—	—	—	126	—	do	1910	do East	do	Gravel	—	90	—	do	—	do	4	0	—	—	—		do
S4	—	—	—	120	—	do	do	do West	do	Cypress Stone	—	90	—	do	—	do	4	0	—	—	—		do
	OAK - POST																					
	CREOSOTE																					
6.1	7'0"x8.5"	—	—	50	—	—	1910	Birmingham, Ala	Q. & C.	Slag	—	75	—	None	—	1912	2	0	—	—	—		3.10
	UNTREATED																					
7.1	—	—	—	50	—	—	1910	Alabama	I.C.I.	—	—	—	—	Gallic	—	1914	4	0	—	—	—	No results yet. Includes 8% dec'yed	21.00
	TABLE 20 OAK-RED																					
	CREOSOTE																					
1.1	—	—	—	200	—	8.0	1910	Texas	St.Louis W.	—	—	—	—	—	—	1914	4	0	—	—	—	Measured 18 mo after treatment	30.10
1.2	7'x8'x8'-6"	—	—	3789	2.5 Gal	—	1907	Scio, Ohio	Pa. Cy. Tie	—	—	—	—	—	—	1912	5	0	—	—	—		20.00
1.3	7'9"x8'-6"	Sawed on return	Peeled and Seasoned	872	do	—	1911	Windsor, Ohio	B&O	Gravel	Good	90	Cut	Shoulder Flange	Fairly Heavy	1915	4	0	—	—	—	Max Pressure 175 # per Sq. In. Max Temp. 180° F. for 4 hrs Hours	500 2.00 4.10
	CREOSOTE - FULL CELL																					
2.1	—	—	—	60	—	8.34	1910	Lines West	C.B.&Q.	Cypress Stone	Very Dry	90	—	Yes	—	1914	5	0	—	—	—		5.00
2.2	—	—	—	60	—	do	1909	do	do	Cedar Gravel Burnt Clay	—	85-90	—	do	—	do	4	0	—	—	—		do
2.3	—	—	—	97	—	do	1908	Lines East	do	Gravel	—	90	—	No Curves	—	do	6	0	—	—	—		do
2.4	—	—	—	108	—	do	1909	do	do	Cedar Gravel Burnt Clay	—	90-95	—	Partly	—	do	5	1.8	split	—	—		do
2.5	—	—	—	56	—	do	1910	do	do	Gravel	—	90	—	All	—	do	4	0	—	—	—	1 split - 1 decayed	do
2.6	—	—	—	85	—	do	1911	do	do	do	—	75	—	Except under Joints	—	do	3	0	—	—	—		do
2.7	7'9"x8'	—	—	82	—	5.4	1910	Easley, Ala.	T.C.Y.R.	—	—	—	—	No Curves	—	do	4	9	—	—	—	2% Partly decayed	21.00
J 8	6'-6"-9'	Hewn	—	53	—	10.9	1911	Hartford, Mo	L.M.&S.F.	Gravel	Good	90	Some	Yes	Heavy	1914	3	0	—	—	—	5.6% Partly Split	27.00
J 9	do	do	—	52	—	do	do	do	do	do	do	90	Cut	None	do	do	3	0	—	—	—	do	do
U 8	do	do	Air Seasoned	99	—	14.0	1909	Taylorville Ind	I.C.&S.	do	do	65	do	do	Light	do	5	0	—	25% Red	—	Electric Ry. 16% Partly Split & Decay	25.00
U 9	do	do	do	53	—	12.0	do	do	do	do	do	65	do	do	do	do	5	0	—	25% do	—	do 15% Red Cut & Split	do
U 10	do	do	do	430	—	7-8	do	do	do	do	do	65	do	do	do	do	5	0	—	70 Red	—	do 5.6% Split	do
	CREOSOTE - GIUSSANI																					
X1	—	—	—	7	—	—	1905	Cincinnati Ry.	G.C.T.S.A.	Slag	—	60	Cut	None	Heavy	1911	6	0	—	—	—		11.00
X2	—	—	—	7	—	—	do	Empire Beach	Mo. Coal	—	—	—	—	—	—	1914	9	0	—	—	—		3.00
	CREOSOTE - LOW PRESSURE																					
① A1	7'9"-8	—	Seasoned Stks	134	—	5.54	1910	Alabama	T.C.&S.R.R.	—	—	—	—	Gallic	—	—	—	—	—	—	—	No results yet	21.00
A2	—	Hewn	Seasoned	65	4.26 Gal	10.8	do	Dover, Ark.	Rock Island Railroad	—	—	—	—	Flat and Hewn	—	1911	—	—	—	—	—	do	22.00
	CREOSOTE AND CRUDE OIL																					
S1	—	—	—	3	—	—	1911	Bodcaw, Ill.	C.B.&Q.	Gravel	—	95	—	Except under joints	—	1912	1	0	—	—	—		5.00
	CREOSOTE AND CRUDE ASPHALTIC OIL																					
② C.1	6'-8"-8'	Hewn	Seasoned	167	—	8.85 to 26	1909	Taylorville, Ind	I.C.&S.	Gravel	Fair	65	Cut	None	Light	1911	2	0	—	—	—	18.3% split. Absorption not accurate	23.00

① - Max Pressure of 175 # per Sq In at 180° F. for 4 hours - Final Vacuum 26 inch for 30 Minutes
② - Preliminary Temperature 425° F. for 4 hours - Max Pressure 43.5 # per Sq. In. at 176° F. for 4 hours.
③ - do do 3 hours - do 38.5 do 175° F. & 3 hours
④ - do 225° F. for 1 & 3 hours - do 57.0 do 185° F. for 1.5 & 3 hours.
⑤ - Preliminary Vacuum of 10 inch for 1 hour - Max Pressure 165 # per Sq In at 208° F. for 10 hours - Final Vacuum 10 inch for 30 minutes
⑥ Preliminary Temperature 226° F. for 1 hour - Max. Pressure 80 # per Sq. In. for 3 hours

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
CREOSOTE - INJECTING																							
⊕ 7.1	6"-8"-8'	Hewn	Steamed 3 hrs	88	16.4	—	1906	St Clair, Mo.	S/L.V.S.F.	Gravel	Good	Open 20 cells out of 22	Cut	None	Heavy	1914	8	0	—	Good	—	Holes charged 1909	5.00
⊕ 7.2	〃	〃	〃	214	15.2	—	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	8	0	—	〃	—	〃	〃
⊕ 7.3	〃	〃	〃	67	9.63	—	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	8	0	—	〃	—	〃	〃
⊕ 7.4	〃	〃	〃	176	12.4	—	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	8	0	—	〃	—	〃	〃
⊕ 7.5	〃	〃	〃	89	9.45	—	〃	〃	〃	〃	〃	〃	〃	〃	〃	1913	6	0	—	〃	—	〃	30.00
⊕ 7.6	〃	〃	〃	108	9.82	—	〃	〃	〃	〃	〃	〃	〃	〃	〃	〃	6	0	—	〃	—	〃	〃
⊕ 7.7	〃	〃	Seasoned	274	—	5.0	1910	Bloomington, Ill.	I. C.	old Gravel	—	75	—	2 Double in Series	—	1913	3	0	—	〃	—	Weber angle bars	12.00
⊕ 7.8	〃	〃	〃	294	—	〃	1909	Fulton Ky.	〃	Gravel & Clay Sand - Gravel	—	90	—	2 Double in Series	—	〃	4	0	—	〃	—	Continuous angle bars - Plank did not splash out Blocks	〃
⊕ 7.9	〃	〃	〃	294	—	〃	〃	Lula, Miss.	〃	New Gravel	—	75	—	2 Double in Series	—	〃	4	0	—	—	—	Holes bored by Earth mound	〃
⊕ 7.10	〃	〃	〃	274	—	〃	1910	Greenville, Miss.	〃	Dirt	—	75	—	2 Double in Series	—	〃	3	0	—	Good	—	Weber joints	〃
⊕ 7.11	〃	〃	〃	274	—	〃	1909	Gladstone, Ill.	〃	old Rock	—	90	〃	〃	—	〃	4	0	—	〃	—	Continuous angle bars	〃
⊕ 7.12	〃	〃	〃	50	—	5.3	1911	Hartford, Wis.	C.M.St.P.R.R.	Gravel	Good	90	—	—	Heavy	1914	3	0	—	—	—	2% decayed 5% split	22.00
⊕ 7.13	〃	〃	〃	50	—	〃	〃	〃	〃	〃	〃	90	Cut	None	〃	〃	3	0	—	—	—	do	〃
7.14	—	—	—	15	—	—	〃	Bodine Ill	C.B. & Q.	〃	—	75	—	Creosote Oil Coated	—	1913	1	0	—	—	—		5.00
LIQUID, J.M. LONG'S																							
8.1	—	—	Seasoned	90	—	0.135	1910	Greenville, Miss.	L.C.	Dirt	—	75	—	2 Double in Series	—	1913	3	—	—	Poor	—	Water would creep up, where first bolt is over 1/2" was not tight very	12.00
OIL, CRUDE																							
9.1	—	—	—	3	—	—	1911	Bodine, Ill.	C.B. & Q.	Gravel	—	75	—	Creosote Oil Coated	—	1912	1	0	—	—	—		5.00
OIL, CRUDE ASPHALTIC																							
⊕ 10.1	6"-8"-8'	Hewn	Seasoned	172	—	0.25 to 0.5	1909	Taylorville Ind	I.C. & S.	Gravel	Poor	65	Cut	None	Light	1914	5	0	—	Poor	—	10% Split Absorption not accounted	22.00
OIL, FUEL - LOW PRESSURE																							
11.1	—	Hewn	Seasoned	331	3.85 Gal	0.7	1910	Dover N.J.	Pennsylvania Railroad	—	—	—	—	Creosote Oil Coated	—	1911	1	0	—	—	—	No results yet	22.00
OIL, SEMI REFINED - FULL CELL																							
⊕ 12.1	6"-8"-8'	—	—	50	—	3.3	1911	Hartford, Wis.	C.M.St.P.R.R.	Gravel	Good	90	—	Old Holes	Heavy	1914	3	0	—	—	—	4% Mechanically decayed & split	22.00
⊕ 12.2	〃	—	—	50	—	〃	〃	〃	〃	〃	〃	90	Cut	None	〃	〃	3	0	—	—	—	do	〃
CRESERVER DIAMOND WOOD																							
13.1	7"-9"-8'	Hewn	—	500	8.52 Gal.	8.15 Gal.	1907	El Paso	G.H. & S.A.	Clay	—	—	Cut	Shoulder	—	1914	7.5	0	—	Good	—	Time of treatment 18 min.	7.00
SALTS, BARSCHALL HASSELMAN																							
14.1	—	—	—	19	—	—	1908	Beaumont, Tex.	B.E. & S.F.	Sand	Poor	60	Cut	None	Heavy	1908	6	100	—	—	3.89	Age of life estimated by Forest Service Started in Oct and 39% removed 1913	11.00
TIMBER ASPHALT																							
15.1	7"-9"-8.5'	Hewn & Sawed	Peeled & Seasoned	1811	4.74 - 5.42 Gal.	—	1911	Walker, Minn.	B. & O.	Gravel	Good	90	Cut	Shoulder Plates	Fairly Heavy	1915	4	0	—	—	—	Open track Max. Temp 108°F. Min 2.78	5.00 2.78
UNTREATED																							
16.1	—	—	—	50	—	—	1908	Lines East	C.B. & Q.	Gravel	—	90	—	Tie Current	—	1914	6	82	Rot	—	—		5.00
16.2	—	—	—	108	—	—	1909	〃	〃	Cedar Gravel Sand Clay	—	90 & 60	—	Perfly	—	〃	5	69	4	—	—		〃
16.3	—	—	—	25	—	—	1910	〃	〃	Gravel	—	90	—	Full	—	〃	4	2.9	〃	—	—		〃
16.4	—	—	—	59	—	—	1909	Lines West	〃	Cedar Gravel Sand Clay	—	85-90	—	Yes	—	〃	5	11.0	〃	—	—		〃
16.5	—	—	—	15	—	—	1910	〃	〃	Open Stone	—	90	—	〃	—	〃	4	0	—	—	—		〃
16.6	—	—	—	51800	—	—	1903	Tennessee	I.C.	—	—	—	—	—	—	1910	7	3.5	—	—	—		1.10
16.7	—	—	—	22400	—	—	1905	〃	〃	—	—	—	—	—	—	〃	5	11.0	—	—	—		1.10
16.8	6"-8"-8'	Hewn	—	100	—	—	1911	Hartford Wis.	C.M. & St.P.	Gravel	Good	90	—	—	Heavy	1914	3	1	—	—	—	55% Mechanically decayed & Heart Split	27.00
16.9	〃	—	Steamed 48 hrs.	50	—	—	〃	〃	〃	〃	〃	90	Steam	Old Holes	〃	〃	3	0	—	—	—	do	〃
16.10	〃	—	〃	50	—	—	〃	〃	〃	〃	〃	90	Cut	None	〃	〃	3	0	—	—	—	do	〃
16.11	—	—	—	38400	—	—	1909	Tennessee	I.C.	—	—	—	—	—	—	1910	6	4.0	—	—	—		1.10
16.12	—	—	—	48000	—	—	1903	do	〃	—	—	—	—	—	—	〃	7	2.4	—	—	—		〃
16.13	—	—	—	98	—	—	1908	Beaumont, Tex.	B.E. & S.F.	Sand	Poor	60	Cut	None	Heavy	1911	9	100.	—	—	4	Age of life estimated by Forest Service Started in Oct 1908 and 100% removed 1913	11.00

See CYPRESS Logs - No 4, 30

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
20.33	—	—	—	135	—	—	1897	Pittsburg, Pa.	Pa. Sys. Inc.	—	—	—	—	—	—	1905	8	25.	—	—	—	—	1.20
20.34	6"×8'-6"	Waun	Steamed Seasoned	176	—	0.5	1911	Hudson, Wis.	C.M. St. P.	Gravel	Good	95	Cut	None	Average	1915	4	0	—	—	—	—	2.00
②20.35	〃	—	—	50	—	〃	〃	Hartford, Wis.	〃	〃	Good	90	Straw	Hot Plate	Heavy	1910	3	0	—	—	—	15 partly decayed - 6% split	17.00
②20.36	〃	—	—	50	—	〃	〃	〃	〃	〃	〃	90	〃	〃	〃	〃	3	0	—	—	—	〃	〃
②20.37	〃	—	—	109	—	〃	〃	〃	〃	〃	〃	90	Cut	None	〃	〃	3	0	—	—	—	25 partly decayed - 3% split	〃
②20.38	〃	—	—	53	—	〃	〃	〃	〃	〃	〃	90	〃	Hot Plate Salt Water	〃	〃	3	0	—	—	—	〃	〃
20.39	〃	Waun	Steamed Seasoned	300	—	〃	1908	Memphis, Tenn.	〃	〃	—	85	—	None	—	〃	6	8.10	—	—	—	Have removed previous to 1913	6.10
20.40	—	—	—	7906	—	—	1907	Iowa - Dakota	〃	—	—	—	—	—	—	〃	7	21.	Not	—	—	〃	〃
20.41	—	Sawed	Steamed Spr.	25	—	—	1907	Norfolk, Va.	U.S.	—	—	—	—	—	Service	1907	10	100.	—	—	—	Started to fail 1917	16.00
20.42	—	—	—	86	—	Adzed	1908	Steamed Tex.	G.C. & S.F.	Sand	Poor	60	Cut	None	Heavy	1911	9.5	220	—	—	—	Started to fail 1909	11.00
20.43	—	—	—	90	—	0.35	〃	〃	〃	〃	〃	60	〃	〃	〃	1909	7.5	100	—	—	—	〃 1909	〃
20.44	—	—	—	2	—	—	〃	〃	〃	〃	〃	〃	〃	〃	〃	1912	10	500	—	—	—	〃 1906	〃
20.45	—	—	—	—	—	0.513	1903	—	Mohawk	—	—	—	—	—	—	1908	5	—	—	—	5-6	Railroad - brittle	1.00
20.46	—	—	—	285 574	—	—	〃	—	G.T.	—	—	—	—	—	—	〃	5	—	—	—	Entire lot	〃	〃
20.47	—	—	—	10	—	—	1905	Rapids Ont.	New Cent.	—	—	—	—	—	—	1914	9	40	Decay	—	—	〃	2.00
	ZINC CREOSOTE - CARD																						
21.1	—	—	—	585	—	65 lbs. 50 Creo.	1909	Lima Cent.	C.B.Q.	Cinders Gravel Sand Clay	—	Poor 70	—	Partly	—	1914	5	1.8	Split	—	—	〃	5.00
21.2	—	—	—	102	—	〃	1908	〃	〃	Gravel	—	90	—	60 Curves	—	〃	6	0	—	—	—	〃	〃
21.3	—	—	—	220	—	〃	1910	〃	〃	〃	—	90	—	All	—	〃	4	0	—	—	—	〃	〃
21.4	—	—	—	110	—	〃	1911	〃	〃	〃	—	75	—	Straight Curves	—	〃	3	0	—	—	—	〃	〃
21.5	—	—	—	292	—	〃	1907	Lima West	〃	Cinders Gravel Sand Clay	—	85-90	—	Hot	—	〃	5	0.67	—	—	—	〃	〃
21.6	—	—	—	211	—	〃	1910	〃	〃	Lyons Shale	—	90	—	〃	—	〃	4	0	—	—	—	2% split	〃
②21.7	7'-0"-8.5	Sawed Hewn	Adzed and Seasoned	1237	45 lbs. Zinc 50 Creo.	0.22 lbs. Zinc 0.33 lbs. Creo.	1911	Windsor, Ont.	G.W.O.	Gravel	Good	90	Cut	Shoulder Plunge	Partly Heavy	1915	4	0	—	—	—	—	4.00 4.10
	ZINC CREOSOTE - LOW PRESSURE																						
②22.1	6"×8"×8'	Hewn	Air Seasoned	198	—	45 lbs. Zinc 50 Creo.	1909	Taylorville Ind.	I.C.R.R.	Gravel	Fair	65	Cut	None	Light	1913	5	—	—	Steel	—	—	23.00
②22.2	〃	〃	〃	50	—	15.3	1911	Hartland, Wis.	C.M. St. P.	〃	Good	90	Straw	Hot Plate	Heavy	〃	3	—	—	—	—	4% decayed 12% split	23.90
②22.3	〃	〃	〃	50	—	〃	〃	〃	〃	〃	〃	90	Cut	None	〃	〃	3	—	—	—	—	〃	〃
22.4	7'-0"-8"	〃	〃	259	45 lbs. Zinc 50 lbs. Creo.	—	1906	Louisiana	S.P. & S.A.	〃	—	80	〃	Q.T.W.	—	〃	8	1.6	—	—	—	Slight decay	7.00
	ZINC TANNIN - WELLHOUSE																						
See	BLACK OAK Index No's 15.1 & 15.2 Incl				—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
23.1	—	—	—	40	—	—	1902	Topeka, Kan.	A.T. & S.F.	—	—	—	—	—	—	1891	9	378.6	—	—	—	—	2.00
23.2	—	—	—	10	—	0.33	1902	Seymour, Tex.	A.C. & S.F.	Sand	Poor	60	Cut	None	Heavy	1909	7	100	—	—	—	Started to fail 1909	11.00

TABLE 21 OAK-SPANISH

	SALTS, BARSCHALL HASSELMANN																						
1.1	—	—	—	20	—	—	1902	Seymour, Tex.	G.C. & S.F.	Sand	Poor	60	Cut	None	Heavy	1908	6	100	—	—	5	Reported by Forest Service Started to fail 1908	11.00
	UNTREATED																						
2.1	—	—	—	20	—	—	〃	〃	〃	〃	〃	60	〃	〃	〃	〃	6	100	—	—	5.6	〃	〃
	ZINC CREOSOTE - ALLARDICE																						
5.1	—	—	—	10	—	0.30 Zinc 0.6 Creo.	〃	〃	〃	〃	〃	60	〃	〃	〃	1912	12	50	—	—	—	Started to fail 1911	〃
	ZINC TANNIN - WELLHOUSE																						
4.1	—	—	—	20	—	0.33	〃	〃	〃	〃	〃	60	〃	〃	〃	〃	10	45	—	—	—	〃	〃

② - Max. Pressure 200 lbs per Sq. In. at 160° F. for 6.38 Hours

② - Preliminary Steam 22 Inch before Zinc Treatment and 28 Inch before Creosote Treatment - Time 65 minutes - Max. Temperature 155° F. - 160° F. for 4 hours 30 minutes and 6 hours

② - Max. Pressure 185 lbs per Sq. In. - Max. Temperature for Creosote [illegible]

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
										OAK - SWEDISH													
S.1	UNTREATED —	—	—	13000	—	—	—	Kennard	Abbeville	—	—	—	—	—	—	11	68	—	—	—	—		9.00
										OAK - TURKEY													
⊙ 6.1	SALTS, BARSCHALL HASSELMANN —	—	—	19	—	—	1912	Kennard, Tex.	G.C.P.S.P.	Sand	Poor	60	Cut	None	Heavy	1906	4.5	100	—	—	3	Started to fail 1905		11.00
⊙ 7.1	UNTREATED —	—	—	20	—	—	do	do	do	do	do	60	do	do	do	1909	8	100	—	—	4.3	96% removed 1906		do
8.1	ZINC CHLORIDE - BURNETT —	—	—	20	—	0.35	do	do	do	do	do	60	do	do	do	do	7.5	100	—	—	—	Started to fail 1909		do
9.1	ZINC CREOSOTE —	—	—	10	—	0.30	do	do	do	do	do	60	do	do	do	1905	5	100	Pocket Method	—	—	do	1905	do
10.1	ZINC CREOSOTE - ALLARDYCE —	—	—	10	—	0.30 Zn Cl2 0.25 Creos.	do	do	do	do	do	60	do	do	do	1912	10	10	—	—	—	do	1911	do
11.1	ZINC TANNIN - WELLHOUSE —	—	—	20	—	0.33	do	do	do	do	do	60	do	do	do	do	10	90	—	—	—	do	1909	do
										OAK - WATER													
12.1	CREOSOTE - FULL CELL 7"x9"-25' None	—	50	—	12.4	1910	Birmingham, Ala	C.S.	Clay	Good	75	Cut	None	—	1918	8	0	—	—	—			5.10
13.1	ZINC CHLORIDE - BURNETT —	—	—	2	—	—	1912	Kennard, Tex.	G.C.P.S.P.	Sand	Poor	60	do	do	Heavy	do	10	0	—	—	—			11.00
										OAK - MISSISSIPPI WHITE													
14.1	UNTREATED —	—	Seasoned	274	—	—	1909	Arthur Ky	I.C.	Gravel	—	90	—	Hewed Square	—	1913	4	20	Decay	—	—	Continuous angle bars		12.00
										OAK - TENNESSEE WHITE													
15.1	UNTREATED —	—	Seasoned	274	—	—	1909	Arthur Ky	I.C.	Gravel	—	90	—	Hewed Square	—	1913	4	6.4	Decay	—	—	Continuous angle bars		12.00
										TABLE 22 OAK - WHITE													
1.1	CREOSOTE —	—	—	15	—	—	1910	Houston, Tex.	C.B.&Q.	Shandon Gravel	—	90	—	Hewed Square	—	1912	8	0	—	—	—			5.00
1.2	—	—	—	10	—	—	do	Blandinsville, Ill.	do	do	—	90	—	do	—	do	2	0	—	—	—			do
1.3	—	—	—	15	—	—	do	Carr, Colo.	do	Lyons Shale & Clay	Clay	90	—	Hewed	—	do	2	0	—	—	—			do
1.4	—	—	Seasoned None	300	—	8	do	Tennessee, Tex.	M.L.&S.W.	—	—	—	—	—	—	1914	4	0	—	Good	—	Piled upon other treating		30.10
	SALTS, BARSCHALL HASSELMANN																						
⊙ 2.1	—	—	—	196	—	—	1912	Kennard, Tex.	G.C.P.S.P.	Sand	Poor	60	Cut	None	Heavy	1912	10	85	—	—	8	Started to fail 1916 - 45% cut out by 1918		11.00
	UNTREATED																						
3.1	—	—	—	56	—	—	1909	Lucas, East	C.B.&Q.	Quincy Gravel Co. South Quincy	—	75-95	—	Partly Hewed	—	1910	5	2.8	—	—	—	2.5% Partially decayed		5.00
3.2	—	—	—	25	—	—	1910	do	do	Gravel	—	90	—	Full	—	do	4	0	—	—	—	2.0% do		do
3.3	—	—	—	20	—	—	1909	Lucas, West	do	Quincy Gravel Co. South Quincy	—	90-95	—	Hewed	—	do	5	0	—	—	—			do
3.4	—	—	—	24	—	—	1910	do	do	Shaw Quarry	—	80-90	—	do	—	do	4	4	—	—	—			do

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309	—	—	—	179534	—	—	1905	Illinois	C.B.&Q.	—	—	—	—	—	—	—	1910	5	4.8	—	—	—			1.10
310	—	—	—	55500	—	—	1899	do	C.I.T.S.	—	—	—	—	—	—	—	1909	11	55.5	—	—	—	Includes Red Oak		do
311	—	—	—	38400	—	—	1906	Vicksburg	I.C.	—	—	—	—	—	—	—	"	3	4.0	—	—	—			12.20
312	—	—	—	8400	—	—	1901	Memphis	do	—	—	—	—	—	—	—	"	8	100	—	—	3-5	Average life estimated by Forest Service		do
313	7'-2"x9'	—	—	12800	—	—	1902	do	do	—	—	—	—	—	—	—	"	7	7.3	—	—	—			do
314	7'-0"x12.5'	—	—	12800	—	—	do	do	do	—	—	—	—	—	—	—	"	7	0.9	—	—	—			do
315	—	—	—	2100	—	—	1906	Birmingham	do	—	—	—	—	—	—	—	"	3	2.6	—	—	—			do
316	—	—	—	1800	—	—	1903	Tennessee	do	—	—	—	—	—	—	—	"	6	3.0	—	—	—			do
317	—	—	—	19376	—	—	1903	Louisville	do	—	—	—	—	—	—	—	"	7	2.1	—	—	—			do
318	—	—	—	413434	—	—	1899	Omaha	do	—	—	—	—	—	—	—	"	10	4.0	—	—	—			do
319	—	—	—	59400	—	—	1900	Dubuque	do	—	—	—	—	—	—	—	"	9	1.3	—	—	—			do
320	—	—	—	25344	—	—	1898	do	do	—	—	—	—	—	—	—	"	11	5.3	—	—	—			do
321	—	—	Seasoned	574	—	—	1909	Fulton Ky.	do	Gravel	—	90	—	1 Treated Trestle	—	—	1913	4	5.4	Decay	—	—	1% broken - Continuous Angle bars		12.00
322	—	—	do	274	—	—	do	do	do	do	—	90	—	do	—	do	do	4	20.	do	Hot Coal	—	0.4% do do		do
323	—	—	do	874	—	—	do	Lake, Miss.	do	New Gravel	—	75	—	1 Treated Stringers	—	do	do	4	—	—	—	—	Damaged by derailment 40 Tober bars		do
324	—	—	do	274	—	—	do	do	do	do	—	75	—	do	—	do	do	4	—	—	—	—	do do		do
325	—	—	do	547	—	—	do	Kewaunee, Ill.	do	old Rock	—	90	—	1 Treated Stringers	—	do	do	4	0.5	Decay	—	—	Continuous Angle Bars		do
326	—	—	do	274	—	—	1910	Shawneetown, Ill.	do	old Gravel	—	75	—	1 Treated Stringers	—	do	do	3	0.4	do	—	—	Weber Angle Bars		do
327	—	—	do	274	—	—	do	do	do	do	—	90	—	do	—	do	do	3	0.4	do	—	—	do		do
328	—	—	—	351,600	—	—	1899	Iowa	do	—	—	—	—	—	—	—	1910	11	50.	—	—	—			1.10
329	—	—	—	455300	—	—	1906-7	Arkansas	S.R.S.&P.	—	—	—	—	—	—	—	do	3-4	11.	—	—	—			do
330	—	—	—	101700	—	—	1903	Toledo	do	—	—	—	—	—	—	—	do	7	9.2	—	—	—			do
331	—	—	—	348100	—	—	1906-7	Arkansas	do	—	—	—	—	—	—	—	do	3-4	12.	—	—	—			do
332	—	—	—	137200	—	—	1907	do	do	—	—	—	—	—	—	—	do	3	9.	—	—	—			do
333	—	—	—	59900	—	—	1903	Louisiana	La. & Ark.	—	—	—	—	—	—	—	do	7	5.5	—	—	—	Includes Post Oak		do
334	—	—	—	342400	—	—	1905	Mo. & Ark.	St.L.I.M.&S.	—	—	—	—	—	—	—	do	5	30.	—	—	—			do
335	—	—	—	9756	—	—	1902	Missouri	K.C.P.&G.	—	—	—	—	—	—	—	do	8	5.2.	—	—	—			do
336	—	—	—	16915	—	—	1901	Pennsylvania	P.R.R.	—	—	—	—	—	—	—	do	9	9.4.	—	—	8.6	All out by 1910		10.5
337	—	—	—	50	—	—	1907	Janesville, Wis.	C.M.St.P.	Gravel	Good	90	Cut	None	—	1915	7.5	36.0	Decay	—	—	8.6	All Partly decayed		23.0 20.00
338	—	Horn	Seasoned White	500	—	—	1897	Norfolk	N.&W.	—	—	—	—	—	—	—	1912	13	100	—	—	8.6	Started to fail 1900 About 1910		16.00
339	—	—	—	196	—	—	1902	Seasoned Birch	G.C.N.S.P.	Sand	Poor	60	Cut	None	Heavy	do	10	85	—	—	—	6.75	Started to fail 1908		11.00
340	7'-0"x8.5'	—	Seasoned	760	—	—	1911	Winslow, Ohio	B.&O.	Gravel	Good	90	Cut	Shoulder Plates	Fairly heavy	1915	4	0	—	—	—	—			5.75
341	—	—	do	—	—	—	—	—	C.B.&Q.	—	—	—	—	—	—	—	—	—	—	—	—	10.0	80% of failures due to decay		33.00
342	—	—	—	57600	—	—	1905	Michigan	L.S.&I.	—	—	—	—	—	—	—	1910	14	100	—	—	—			4.10
343	7'-0"x8'	—	—	75	—	—	1911	Dwight, Mo.	C.M.&St.P.	Sand Clay	Good	85	Cut	None	Heavy	1915	4	0	—	—	—	—			6.00
344	6'-8"x8'	—	—	280	—	—	do	Grayson, Mo.	do	do	do	85	do	do	do	do	4	—	—	—	—	—			do
345	do	—	—	500	—	—	1903	Washington, Ind.	do	Gravel	do	85	do	do	do	do	12	6.4	Decay & Split	—	11-12		First remoted in 1913		do
346	—	—	Seasoned	—	—	—	Averaged from reports of 28 Railroads															8.25	Avg. for Southern States 5 Yrs		33.00
See CYPRESS Index No. 4.36 - 4.38																									
See POST OAK Index No. 7.1																									
WOOD TAR CREOSOTE																									
4.1	—	—	—	104	—	—	1898	N.Y. & Flush	N. Syston	—	—	—	—	—	—	—	1914	—	100	Decay	—	7.0			20.10
WOOD TAR CREOSOTE - DIPPED																									
5.1	—	—	—	435	—	—	1910	do	do	—	—	—	—	—	—	—	do	—	100	Wear under rails	—	9			do
																							Proposed 1 Heavy		

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	HARD PINE - CREOSOTE - BOUCHERIE																							
6.1	—	—	—	80	—	—	1907	Gulf & Ship'n	Ft. Pinckney	—	—	—	—	—	—	1909	—	100	Creosy	—	2.5			20.10
	HARD OAK CREOSOTE - QUARTER SAWN																							
7.1	—	—	—	300	—	—	1905-7	do	do	—	—	—	—	—	—	do	—	100	do	—	4.0			do
7.2	—	—	—	600	—	—	do	Kansas City Term.	do	—	—	—	—	—	—	do	—	100	do	—	2.5			do
7.3	—	—	—	85	—	—	1907	do	do	—	—	—	—	—	—	do	—	100	Water soak	—	—			do
	HARD TAR CREOSOTE - BROWN																							
8.1	—	—	—	537	—	—	1904-5	do	do	—	—	—	—	—	—	do	—	100	Decay	—	2.5			do
8.2	—	—	—	300	—	—	1907	Baltimore, Md.	do	—	—	—	—	—	—	do	—	100	Wood Cell & Decay	—	3.0			do
8.3	—	—	—	306	—	—	do	do	do	—	—	—	—	—	—	do	—	100	Decay	—	2.0			do
8.4	—	—	—	377	—	—	1907-8	do	do	—	—	—	—	—	—	do	—	100	do	—	3.0			do
8.5	—	—	—	72	—	—	1908	do	do	—	—	—	—	—	—	do	—	100	do	—	3.0			do
8.6	—	—	—	301	—	—	1907-8	do	do	—	—	—	—	—	—	do	—	100	do	—	3.5			do
8.7	—	—	—	252	—	—	1908	do	do	—	—	—	—	—	—	do	—	100	do	—	10.0			do
	ZINC CHLORIDE - BURNETT																							
9.1	—	—	—	15	—	0.5	1901-10	Hanover Jct	C.B.&Q.	Florida Canal	—	90	—	Ash	—	1901-2	2	0	—	—	—			5.00
9.2	—	—	—	10	—	do	1901-10	Bleeding Jct	do	do	—	90	—	do	—	do	2	0	—	—	—			do
9.3	—	—	—	15	—	do	1901-10	River Falls	do	Lyons Shore	—	90	—	do	—	1901-10	2	0	—	—	—			do
9.4	—	—	—	101	—	0.25	1906	Beaumont, Tex.	S.P. Co. R.R.	Sound	Pier	80	Cut	None	Heavy	1902	10	60	—	—	—	Started to Fail 1910		11.00
● 9.5	—	—	—	100	—	0.35	do	do	do	do	do	60	do	do	do	1909	7.5	100	—	—	4.10	10% Failed 1909 25% " 1909		do
	ZINC CREOSOTE - ALLAROYCE																							
10.1	—	—	—	100	—	0.35 gal. & 2.0 Zn Cl	do	do	do	do	do	60	do	do	do	1902	10	71	—	—	—	Started to Fail 1908		do
	ZINC CREOSOTE - BEAUMONT																							
● 11.1	—	—	—	107	—	0.2 Zn Cl	do	do	do	do	do	60	do	do	do	1905	2.5	100	—	—	2.15	do	1905	do
	ZINC CREOSOTE - CARD																							
12.1	—	—	—	162	—	0.5 Creo. 2.0 Zn Cl	1909	Lyons Shore	C.B.&Q.	Anchor Canal Basin Slip	—	Piling	—	Partly	—	1910	5	3.1	Sticky Spot	—	—			5.00
12.2	—	—	—	376	—	do	1908	do do	do	Gravel	—	90	—	All	—	do	6	0	—	—	—			do
12.3	—	—	—	75	—	do	1910	do do	do	do	—	90	—	do	—	do	4	0	—	—	—			do
12.4	—	—	—	98	—	do	1909	do West	do	Anchor Canal Basin Slip	—	80-90	—	do	—	do	5	0	—	—	—			do
12.5	—	—	—	60	—	do	1910	do do	do	Lyons Shore	Way Dry	90	—	do	—	do	4	0	—	—	—			do
	ZINC TANNIN - WELL HOUSE																							
13.1	—	—	—	100	—	0.35	1902	Beaumont Tex.	S.P. Co. R.R.	Sound	Pier	60	Cut	None	Heavy	1912	10	5	—	—	—	Started to Fail 1908		11.00
13.2	—	—	—	100	—	0.35	do	do	do	do	do	60	do	do	do	do	10	92	—	—	—	do		do
	OAK - WILLOW																							
	SALTS - BARSCHALL MASSELMANN																							
14.1	—	—	—	80	—	—	1902	Beaumont Tex.	S.P. Co. R.R.	Sound	Pier	60	Cut	None	Heavy	1908	4.5	100	—	—	—	Started to Fail 1908 65% removed 1915		11.00
	UNTREATED																							
15.1	—	—	—	10	—	—	do	do	do	do	do	do	do	do	do	do	4.5	100	—	—	—	do 75% do		do
	ZINC CHLORIDE - BURNETT																							
16.1	—	—	—	20	—	0.35	do	do	do	do	do	do	do	do	do	1909	7.5	100	—	—	—	Started to Fail 1909		do
	ZINC CREOSOTE - ALLAROYCE																							
17.1	—	—	—	10	—	0.35 Creo. 2.0 Zn Cl	do	do	do	do	do	do	do	do	do	1911	2	100	—	—	—			do
17.2	—	—	—	11	—	0.2 Zn Cl Heavy Creo.	do	do	do	do	do	do	do	do	do	1905	3.5	100	—	—	—	Started to Fail 1905		do
	ZINC TANNIN - WELLHOUSE																							
18.1	—	—	—	20	—	0.35	do	do	do	do	do	do	do	do	do	1911	0	100	—	—	—	Started to Fail 1908 40% removed 1908		do
18.2	7"x9"x8'	—	—	35	—	—	1910	Cosby, Ala.	T.C.&I.R.R.	—	—	—	—	Ash Cement	—	1910	4	20	—	—	—	40% Partially decayed		21.00

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TABLE 22a — OHIA

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
UNTREATED																							
1.1	—	Sawn	Air seasoned	108	—	—	1910 1918	Adzed one edge	ATS.F.	Rock	—	90	Screw	7/8 x 9	—	1915	5	0	—	—	—	—	9500
1.2	—	Hewn	do	132	—	—	1910	do	ATS.F.	do	—	90	do	7/8 x 9	—	1915	5	0	—	—	—	—	9500

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TABLE 23 PINE

	CARBOLINEUM																						
1.1	—	—	—	10	—	—	1905	Niagara Branch	New York	—	—	—	—	—	Branch Line	1914	9	90	Decay	—	Hyget		2.00
2.1	**CARBOLINEUM - ARMARINE** —	—	—	84	—	—	1905	Stevenson Mo.	S.F. & S.P.	Sound	Poor	60	Cut	None	Heavy	1909	4	91.7	—	—	—	Marked to Feb 1906	11.00
3.1	**COPPER SULPHATE** 5/8-8'-8.33	—	—	184511	—	0.4 Dry	—	Prance	Authorities	—	—	—	—	—	—	—	—	—	Decay - Bor	—	6-10		2.20
4.1	**COPPER SULPHATE - STEEPING** 5/8-8'-8'-10"	—	—	32.348	—	—	1887-9	Germany	Railway Superintendent	—	—	—	—	—	—	1864	11	82	—	—	9.6		6.25
5.1	**CREOSOTE** —	—	—	—	—	12	1904	—	U.C.S. Ry	—	—	—	—	—	—	1908	4	—	—	—	6-10	40 records left - 3 removed new cards	1.99
5.2	—	—	—	16000	—	—	1907	—	Mo. P. Coal	—	—	—	—	—	—	—	1	0	—	—	—		1.00
5.3	—	—	—	17	—	—	1905	Niagara Branch	New York	—	—	—	—	—	Branch Line	1914	9.5	0	—	—	—		3.00
5.4	—	—	—	11	—	—	do	do	do	—	—	—	—	—	—	do	9.5	0	—	—	—		do
5.5	7'-7'-8'	—	—	6000	—	10	1898	New Jersey Sun	B.K.W.H.	—	—	100	Cut	None	New Line	do	19.5	100	—	—	16	Avg. life estimated by Road Masters	do
5.6	—	—	—	—	—	—	—	Prance	—	—	—	—	—	—	—	—	—	—	—	—	20	Unmarked life 7 to 8 years	12.10
5.7	6½-10-8-10	—	—	—	58.6	—	—	Germany	Germany Railroad	—	—	—	—	—	—	1896	—	—	—	—	20		15.00
5.8	do	—	—	—	79.2	—	—	do	do	—	—	—	—	—	—	do	—	—	—	—	23		do
5.9	—	—	—	—	—	—	—	—	Germany R.R.	—	—	—	—	—	—	—	—	—	—	—	20		2.00
5.10	—	—	—	150000	—	10	1880	—	H.T.T.C.	—	—	—	Cut	Q.W.	—	1906	26	92.5	—	—	19		1.00
5.11	Bridge Ties	—	—	15000	12-18	—	1898	—	L.P.H.	—	—	—	—	—	—	1896	18	45.00	Flood	—	—	Flood 1896 - Records Lost	do
5.12	do	—	—	1893	20-22	—	1899	—	do	—	—	—	—	—	—	1905	16	72	Cut Out	—	—		do
5.13	—	—	—	—	—	—	1899	Texas	H.T.T.C.	—	—	—	—	—	Heavy	1899	20	20	Rail Cut	—	—		2.00
	CREOSOTE - FULL CELL																						
6.1	5/8-8'-8"	—	—	—	35-44	—	—	Prance	Orleans	—	—	—	—	—	—	—	—	—	—	—	15-16	Epoxy	2.20
6.2	6½-10'-8"	—	—	968	44 Gal	1.826 Gal	1899	Rio Grande R.R.	S.N.O.S.A.	Gravel	—	80	Steam Relaying	Rail Tamper	—	1914	14.8	0	—	Good	—	Show marked signs of decay	7.00
6.3	7'-9'-8"	Hewn	—	181	—	12	1907	Delaware and Hudson	do	do	—	—	Cut	C.S. 37	—	do	7	0	—	do	—		do
6.4	do	do	—	245	—	12	do	Los Angeles	do	do	—	—	—	Q.W.	—	do	7	0	—	do	—		do
6.5	do	do	—	285	—	12	1906	do	do	do	—	—	—	do	—	do	7	0	0.2	Dec	—	7½% absorped	do
6.6	—	—	—	3105	—	—	do	San Leandro	do	do	—	—	—	—	—	do	7	0	—	Good	—		3.00
6.7	6-10'-8"	—	—	1985	—	1.3	1911	Mississippi	do	Gravel	—	90	Steam	Rail Tamper	—	do	7	0	0.0	do	—		2.00
6.9	do	—	—	249	—	do	do	do	do	do	—	90	do	Rail Tamper	—	do	7	0	0.0	do	—		do
6.9	do	—	—	295	—	do	do	do	do	do	—	90	do	do	—	do	7	0	0.0	do	—		do
6.10	do	—	—	931	—	do	do	do	do	do	—	90	do	do	—	do	7	0	0.0	do	—		do
	CREOSOTE - GIUSANI																						
7.1	—	—	—	29	—	—	1905	Temple Branch	New York	—	—	—	—	—	Branch Line	1914	9.5	0	—	—	—		2.20
	CREOSOTE - LOWRY																						
7.21	7'-9'-8"	—	Seasoned	99	8.5 Gal	—	1915	Wilmer, N.J.	D.L.P.W.	Stone	Good	101	Steam	Steam Tamper	—	1915	—	—	—	—	—		44.00
7.22	do	—	do	37	do	—	do	Dover, N.J.	do	do	do	101	do	do	—	do	—	—	—	—	—		do
	CREOSOTE - LOW PRESSURE																						
8.1	7'-9'-8"	—	Not Seasoned	189	—	7.0	1910	Alabama	I.C.S.R.R.	—	—	—	—	Rubble	—	do	4	17	—	—	—		21.00
	CREOSOTE - AUEPINE																						
9.1	—	—	—	—	—	5.0	1905	—	C.N.O.S.P.	—	—	—	—	—	—	1908	3	0	—	—	—	No record	1.00
9.2	—	—	—	146	—	—	do	Niagara Branch	New York	—	—	—	—	—	Branch Line	1914	9.5	0	—	—	—		3.00
9.3	7'-8'-8"	Hewn	—	85	—	—	1907	Delaware & Hudson	G.N.O.S.A.	Gravel	—	—	Cut	C.S. 37	—	do	7.0	0	—	Good	—		2.20
9.4	do	do	—	10	—	—	do	do	do	do	—	—	do	do	—	do	7.5	0	—	do	—		do
9.5	do	do	—	13	—	—	do	Lafayette Street	do	do	—	—	do	Q.W.	—	do	7.5	0	—	Rail Cut	—		do
9.6	do	do	—	77	—	—	do	do	do	do	—	—	do	do	—	do	7.5	0	—	do	—		do
9.7	—	—	—	2.176.417	—	4.5 & 5.0	1906	—	A.T. & S.F.	—	—	—	—	—	—	1913	3	—	—	—	—	No results	1.00

No mud Lbs.

O Max Pressure 40# per sq in. at 190°F for 2.5 Minutes - Final Vacuum 12 Inch - Air blow preservative back to measuring Tank.

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CREOSOTE - MISSISSIPPI

9.8	—	Hewn.	Air Seasoned	179	—	4.56	1905	Chillicothe, Mo	A.T. & S.F.	Gravel	—	85	Cut	6x9	10 152 780	1915	10	5.8	Wear	—	—		45.00
9.91	—	do	do	304	—	4.56	do	Marceline Mo	do	do	—	85	do	6x8	10 869 895	do	10	36.9	Decay-wear	—	—		do
9.82	—	do	do	44	—	4.56	do	Sutha Ks.	do	Slag	—	85	do	6x8	6 999 248	do	10	9.1	Wear	—	—		do
9.83	—	do	do	190	—	4.56	1904	Ponca City Okla	do	Rock	—	90	do	7x9	2 880 296	do	11	4.2	do	—	—		do
9.84	—	Sawn.	do	275	—	3.98	do	Elgin Okla	do	do	—	90	do	do	do	do	11	2.3	do	—	—		do
9.85	—	do	do	366	—	3.93	do	Perry Okla	do	do	—	90	do	do	do	do	11	0	—	—	—		do
9.86	—	Hewn.	do	27	—	4.56	do	do	do	do	—	90	do	do	do	do	11	0	—	—	—		do
9.87	—	Sawn.	do	384	—	3.93	1905	Garnett Ks.	do	do	—	90	do	do	4 821 390	do	10	7.3	Decay	—	—		do
9.88	—	do	do	572	—	3.93	do	Argonia Ks	do	do	—	90	do	do	8 181 806	do	10	9.8	—	—	—		do
9.89	—	Hewn	do	54 621	—	5.00	1910	Hutchinson Kans	do	do	—	90	Screw	do	—	do	5	7	—	—	—		do
9.90	—	Sawn	do	9 436	—	5.00	1910	do	do	do	—	90	do	do	—	do	5	0	—	—	—		do
9.91	—	Hewn	do	24238	—	5.00	1906	Ottawa Kans	do	do	—	90	Cut	7½x9 6x8	9 337 687	do	9	0	—	—	—		do

Three Boiler Treatment

① Preliminary air - 60# Pressure for 45 min. Creo — at 109° pressure for 1hr. 45 min at 120° F.

② Preliminary air - 65# Pressure for 30 min. Creo — at 104° pressure for 1hr 15 min at 128° F.

③ Preliminary air - 85# Pressure for 25 min. Creo — at 135° pressure for 1hr 45 min at 109° F. Final vacuum - 22 inch - 1hr same

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See	Size	Treatment	Seasoning	Preservative	Retention	Penetration	Year	Species	Source	Condition	Method	Kind	Preservative	Year	Age	Failures	Total	Failed	Life	Remarks	Cost
⊕ No.1	7"×9"×8'	—	Not Seasoned		100	—	Not Dry	1910	Alabama	K.C.S.&N.	—	—	—	—	Cubic	—	1914	4	3	—	—	—	4" Sand - 6" Earth, all charred, 48" deep	$1.00
	DIAMOND GLUE PRESERVATIVE																						
11.1	—	—	—		19	—	—	1908	Rosamond, Tex.	A.C.+S.R.	Sand	Post	60	Cut	None	Heavy	1908	6	100	—	—	2.85	Started 8 Feb'd 1914 Drip 1.16 estimated by Forest Service	11.00
	MERCURIC CHLORIDE - (KYAN)																						
12.1	—	—	Green		—	—	—	1885	—	B.+A.R.R.	—	—	—	—	—	—	—	—	—	—	—	—	Includes Spruce Heavily charged	2.40
	SALTS - BARSCHALL HASSELMANN																						
13.1	—	—	—		37999	—	—	1902	—	C.B.+Q.	—	—	—	—	—	—	1908	6	—	—	—	—	Good Failure	1.00
13.2	—	—	—		94	—	—	do	Rosamond, Tex.	R.F.+S.F.	Sand	Post	60	Cut	None	Heavy	1912	10	99.5	—	—	4.0	Started 8 Feb'd 1902 Drip 2.16 estimated by Forest Service	14.00
	UNTREATED																						
⊕ 14.1	7"×9"×9'	—	Air Seasoned		25	—	—	1907	Lafayette, La.	B.M.+S.A.	Gravel	—	—	Cut	Sprms	—	1914	3.67	100	—	—	3.67		3.00
⊕ 14.2	do	—	do		75	—	—	do	do	do	do	—	—	do	Slaughter	—	do	2.69	100	—	—	2.67		do
14.3	—	—	—		—	—	—	—	France	—	—	—	—	—	—	—	1895	—	—	—	—	7.8		10.10
14.4	—	—	—		267.28	—	—	1858	Germany	Pinus M. Variety Scots Pine	—	—	—	—	—	—	1880	7	100	—	—	5.1		12.70
14.5	—	—	—		258640	—	—	do	do	Pinus M. Variety Scots Pine	—	—	—	—	—	—	do	9	100	—	—	5.2		do
	See Cedar Index Nos 1.1 and 1.2																						
	See Cypress Index Nos 4.36 and 4.37																						
	VARIOUS PROCESSES																						
15.1	—	—	—		831.361	—	—	—	Germany	Steinbrück	—	—	—	—	—	—	1880	—	—	—	—	14.		29.70
	VULCANIZED																						
⊕ 16.1	—	Sawed	Seasoned from Sap Stage Heart Dried		25	—	—	1897	Norfolk, Va.	N. S.	—	—	—	—	Jervis	—	1910	—	100	—	—	3.5	Started 8 Feb'd 1897 All well 1908	18.00
⊕ 16.2	—	Hewn	do		25	—	—	do	do	do	—	—	—	—	None	—	do	—	100	—	—	2.3	do do 1900	do
⊕ 16.3	—	do	do		100	—	—	do	do	do	—	—	—	—	—	—	do	—	100	—	—	2.1	do do 1900	do
⊕ 16.4	—	Sawed	do		100	—	—	do	do	do	—	—	—	—	—	—	do	—	100	—	—	4.3	do do 1906	do
⊕ 16.5	—	do	do		46	—	—	do	do	do	—	—	—	—	—	—	do	3	93.4	—	—	3.0	do do 1900	do
	ZINC CHLORIDE - BURNETT																						
	See FIR Index Nos 11.1 To 11.4 incl.																						
17.1	—	—	—		11827	—	—	1899	California	A.F.+S.P.	—	—	—	—	—	—	1910	1	10	Varners	—	—		1.10
17.2	—	—	—		1016.581	—	.35 lb. 50	1885	—	do	—	—	—	—	—	—	1908	—	—	—	—	14.55	Life in dry regions 10.2 To 18.4 yrs	1.00
17.3	6"×8"×8'	Hewn	Air Seasoned		496	—	0.5	1906	Black Hills, Wis	C.M.+St.P.	Gravel	Good	65	Cut	None	Light	1918	4	0	—	Good	—		6.10
17.4	—	—	—		43	—	—	1905	Thapsis Beach	Nav. Const.	—	—	—	—	—	—	1914	98	0	—	—	—		3.00
⊕ 17.5	—	Hewn	Seasoned from Sap Stage Heart Dried		25	—	—	1897	Norfolk, Va.	N. S.	—	—	—	—	—	—	do	17	68	—	—	15	Began to Fail 1907	16.00
⊕ 17.6	—	Sawed	do		100	—	—	do	do	do	—	—	—	—	—	—	do	17	82	—	—	1.5	do 1904	do
⊕ 17.7	—	Hewn	do		100	—	—	do	do	do	—	—	—	—	—	—	do	17	66	—	—	1.8	do 1907	do
⊕ 17.8	—	—	—		142000	—	—	1886	Wyoming	U.P.	—	—	—	—	—	—	1897-8	12-13	100	—	—	9	do 1903	2.00
17.9	8"×12"×6'	—	—		2562	—	.35	1907	Hobson	G.N.	Gravel	Poor	85	½ Cut ½ Uncut	Chestnut Tannin Extract Process	—	1914	7	89	Dewey	—	—	Includes Treenail. For U Service	48.00
17.10	—	Triangular	—		2601	—	0.5	1902	Conrad	do	do	do	68	do	None	—	do	12	83.5	—	—	12	83% decayed - 1907 and U Service Includes Treenails For U Service	do
17.11	—	—	—		4.580.000	—	0.25	1888	—	T.+P.M.R.	—	—	—	—	—	—	1900	10	—	—	—	10-14		1.00
17.12	—	—	—		380	—	—	1901	Connecticut	N.Y.N.H.+H.	—	—	—	—	—	—	1914	13	0	—	—	—		3.00
17.13	6"×12"×8'-10"	—	—		4836.668	34 Sal.	—	—	Germany	Germanized Silvester Rx.	—	—	—	—	—	—	1896	—	—	—	—	12		13.00
17.14	do	—	—		—	—	—	—	do	Germanized	—	—	—	—	—	—	—	—	—	—	—	12		2.00
See also 18.1	ZINC CHLORIDE STEEPING																						
18.1	6"×12"×8'-10"	—	—		3899	—	—	1852	Germany	Allegany's Kyan Pr.	—	—	—	—	—	—	1867	15	100	—	—	6.0		2.00

⊕ Preliminary Vacuum 12 inch for 1.25 Hours - Boil Temp. 126° for 1.25 Hours - Max Pressure 168 per Sq. In. at 120°F for 18.1 Hours Drip 11 Hours

⊕ Average Life estimated by Forest Service

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ZINC CHLORIDE · BURNETT

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
① 17.15	—	Steam	Horizontal	7251	—	.58	1905	Newton Hs.	AT&SF	Frisch	—	85	Cut	7½ x 9	13 CSV 235	1911	10	32.7	—	—	—	Treating for sap purposes	7350
17.16	—	do	do	6337	—	.58	1904	do	do	do	—	85	do	do	15 039 235	1913	11	355	—	—	—	—	4510
② 17.17	—	Steam	do	2517	—	.52	1904	do	do	do	—	85	do	do	15 039 236	1913	11	119	—	—	—	—	4500
17.18	—	do	do	90	—	.52	1905	do	do	do	—	85	do	do	15 039 236	1915	10	0	—	—	—	—	4500

① Tons Traffic per annum.
② Zinc Chloride at 100# pressure for 2 hrs at 200° F. Initial vacuum 24 inch. 45 min Steam 20# for 2 hr. 50 min
③ Zinc Chloride at 100# pressure for 2 hrs at 200° F. Initial vacuum 24 inch. 45 min Steam 20# for 4 hrs

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19.1	[illegible]	[illegible]	—	2100	—	—	1898	[illegible]	G.N.Y.R.R.	Gravel	—	—	Cut	—	—	1914	20	60	Any kind	—	18.83	Any life estimated by Forest Service	2.00
⊕19.2	—	"	—	900	—	"	1898	[illegible]	"	"	—	—	—	Yes	—	"	19	100	—	—	18.0	"	1.00
⊕19.3	—	"	—	189	—	"	"	"	"	"	—	—	—	None	—	"	19	100	—	—	18.0	"	"
⊕19.4	—	—	—	1098	—	"	"	"	"	Pavement	—	—	—	"	—	"	19	185	—	—	18.0	"	"
⊕19.5	7'0"×8'	Howes	—	433	Kelly & Other systems	— A. Wilcox	1907	Hollingsworth & Sons Co.	"	Gravel	—	—	Cut	1.3 per	—	"	7	—	—	Good	—	6% about decay	2.00
⊕19.6	"	"	—	71	"	"	1905	"	"	"	—	—	"	0 per	—	"	5	—	—	—	—	"	2.00
⊕19.7	"	"	—	476	"	"	"	"	"	"	—	—	"	"	—	"	5	11	Decay	—	—	"	"
19.8	8'×8'×8'	—	Seasoned 8"×16"	—	—	—	—	Germany	Control	—	—	—	—	—	—	—	—	—	—	—	18-18	"	10.10
19.9	5"×8"×8'	—	—	161 215	66	—	—	France	State Ry	—	—	—	—	—	—	—	—	—	Decay	—	14-15	"	9.80
	ZINC CREOSOTE - GILSSANI																						
20.1	—	—	—	19	—	—	1905	Douglas Fir	Wm Cook	—	—	—	—	—	—	1914	9.5	0	—	—	—	"	3.00
	PINE - BALTIC																						
	UNTREATED																						
21.1	—	—	—	—	—	—	—	Denmark	Ekelhoff Bartop	—	—	—	—	—	—	—	9	19	—	—	—	"	9.00
	PINE - BLACKHILLS																						
	ZINC CHLORIDE																						
22.1	—	—	—	6350	—	35-40	1904	Sidney, Neb.	C.B.&Q.	Rock Ground	Very Dry	75	—	Air Curred	—	1914	14	6	Rot	Good	—	"	3.00 3.00
	PINE - BULL																						
	WOOD TAR CREOSOTE																						
23.1	—	—	—	18	—	—	1908	Phila. & Chester	Pa. System	—	—	—	—	—	—	1914	—	100	Decay	—	5	"	20.10
	PINE - COLORADO																						
	ZINC TANNIN - WELLHOUSE																						
24.1	—	—	—	198	—	—	1885	—	A.T.&S.F.	—	—	—	—	—	—	1901	15.1	38	Everywhere	—	—	"	29.20
24.2	—	—	—	195	—	—	"	—	"	—	—	—	—	—	—	"	15.1	92	"	—	—	"	"
24.3	—	—	—	156	—	—	"	—	"	—	—	—	—	—	—	do	15.1	38	do	—	—	"	"
24.4	—	—	—	385	—	—	do	—	do	—	—	—	—	—	—	"	15.4	97	do	—	—	"	do
24.5	—	—	—	50	—	—	1882	Leadville, Colo	"	—	—	—	—	—	—	1897	15.0	100	—	—	11.8	"	2.00
	PINE - DANTZIC																						
	UNTREATED																						
25.1	4.5"×9"	—	—	2500	—	—	1898	Denmark	Perforated Switch	—	—	—	—	—	—	1909	11	19	—	—	—	"	9.00
25.2	do	—	—	20000	—	—	—	do	Vorlegiva	—	—	—	—	—	—	—	16	67	—	—	—	"	do
	PINE, HEART																						
	CREOSOTE - FULL CELL																						
26.1	7'0"×8.5'	Howes	—	50	—	12.4	1910	Brownsburg, Ala	Q.&C.	Slag	—	35	Cut	None	—	1918	8	0	—	—	—	"	3.10
	UNTREATED																						
27.1	—	—	—	158	—	—	1895	Wabash Cable Tramway	G.N.Y.S.A.	Rock	—	—	—	Yes	—	1914	—	100	—	—	9	Any life estimated by Forest Service	7.86
27.2	—	—	—	719	—	—	do	do	do	Earth	—	—	—	do	—	do	—	100	—	—	9	do	do
27.3	—	—	—	769	—	—	do	do	do	do	—	—	—	No	—	do	—	100	—	—	9	do	do
27.4	7'0"×8'	Sawn	—	4	—	—	1905	Big River Timber Trestle	do	—	—	—	Sawn	—	—	do	—	100	—	—	5.5	do	do
27.5	do	do	—	184	—	—	do	do	do	—	—	—	do	—	—	do	—	99.4	—	—	8.9	do	Repaired Fall 1907 do
27.6	do	do	—	388	—	—	do	do	do	—	—	—	—	Alaska	—	do	—	100	—	—	4.07	do	do do
27.7	do	do	—	434	—	—	do	do	do	—	—	—	—	None	—	do	—	99.6	—	—	4.7	do	do do
	TABLE 24 PINE LOBLOLLY																						
	CREOSOTE - FULL CELL																						
1.1	7'0"×8'	Howes	Seasoned box	1000	35	18	1907	Bennett, Ga.	Georgia RR	Cinder	—	65	Cut	None	—	1913	6	0	—	—	—	"	3.10
1.2	7'0"×8.5'	do	—	50	—	17.4	1910	Birmingham, Ala	Q.&C.	Slag	Good	75	do	do	—	1912	2	0	—	—	—	"	do

⊕ Records show an injection of 6# per Cu Ft of Creosote but fail to give the amount of Zinc Chloride used
⊕ Treatment similar to Allardyce but not always followed - 1.3% solution of Zinc Chloride.

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1.3	—	—	—	88	—	22.19	1909	Lucas East	C.B.&Q.	Cedars Gravel Gravel Clay	—	7-8"	—	Partly	—	1914	5	0	—	—	—	——	5.00
1.4	—	—	—	50	—	4	1910	do	do	Gravel	—	90	—	All	—	do	4	0	—	—	—	4% decayed	do
1.5	—	—	—	40	—	4	1909	Lucas West	do	Cedars Gravel Gravel Clay	—	88-90	—	Yes	—	do	5	0	—	—	—	——	do
1.6	CREOSOTE			31	—	4	1910	do	do	Lyons Stone	—	90	—	do	—	do	4	0	—	—	—	——	do
1.7	7 x 8 PILES	—	—	2745	—	30-40	4	Wooster Ohio	Pa. System	—	—	—	—	—	—	1912	2	—	—	—	—	Various track fastenings	20.00
1.8	—	—	Green	297	—	8.0	do	Rockford Ill.	Ill. C.R.R.	—	—	—	—	—	—	1914	4	—	—	—	—	Seasoned 3 mo. after treatment	30.10
1.9	—	—	Seasoned 3 Mo	300	—	8.0	do	do	do	—	—	—	—	—	—	do	4	—	—	—	—	do 4 do	do
	CREOSOTE - RUBPING																						
2.1	—	—	Seasoned	274	—	5.0	1909	Fulton Ky	I.C.	Gravel	—	90	—	1 Double Shoulder	—	1913	4	0	—	Good	—	Continuous angle bars.	12.00
2.2	—	—	do	274	—	do	do	Lake Mass.	do	New Gravel	—	95	—	1 Double Shoulder	—	do	4	—	—	—	—	40" Tubular bars damaged by drawbeard	do
2.3	—	—	do	274	—	do	1910	Greenville Miss.	do	Dirt	—	95	—	1 Double Shoulder	—	do	3	0	—	Good	—	Weber joints 0.8% decayed	do
2.4	—	—	do	274	—	do	1909	Kankakee, Ill.	do	Old rock	—	90	—	do	—	do	4	0	—	do	—	Continuous angle bars	do
2.5	—	—	do	274	—	do	1910	Bloomington Ill.	do	Old Gravel	—	95	—	1 Double Shoulder	—	do	3	—	—	do	—	Weber angle bars	do
2.6	—	—	—	3200	—	do	1907	Corinth Miss	do	Gravel	—	85	—	None	Old Heavy	1914	7	1	—	do	—	Slightly railcut	12.10
2.7	—	—	—	2880	—	6.0	do	do	do	do	—	85	—	do	do	do	7	1	—	do	—	do	do
	LIQUID - A.R.LONG'S																						
3.1	—	—	Seasoned	274	—	8.836	1910	Greenville, Miss.	do	Dirt	—	95	—	1 Double Shoulder	—	1913	3	—	—	Good	—	Weber Joints - Above overlap, Above where dirt covers top of tie	12.00
	OIL, BAKERSFIELD																						
4.1	—	—	—	4	—	—	1908	Seymour Tex.	G.C.&S.F.	Sand	Poor	60	Cut	None	Heavy	1912	10	0	—	Good	—	——	11.00
	OIL, BEAUMONT																						
5.1	—	—	—	42	4.24	—	do	do	do	do	do	60	do	do	do	1911	9	100	—	—	—	Started to Rail and 95% removed 1905	do
	OIL, BEAUMONT AND ZINC CHLORIDE																						
6.1	—	—	—	81	8.0	0.26	do	do	do	do	do	60	do	do	do	1911	9	100	—	—	—	——	do
	SALTS BARSCHALL HASSELMANN																						
7.1	—	—	—	99	—	—	do	do	do	do	do	60	do	do	do	1906	4	100	—	—	4.3	Started to Rail 1905 12% out	do
	SPIRITTINE																						
8.1	—	—	Seasoned	100	—	3.3	do	do	do	do	do	60	do	do	do	1911	4	100	—	—	3.6	60% removed 1905 - 12% removed 1906	do
	UNTREATED																						
9.1	—	—	—	110	—	—	1909	Lucas East	C.B.&Q.	Cedars Gravel Gravel Clay	—	7-8"	—	Partly	—	1914	5	73	Mod	—	—	——	5.00
9.2	—	—	—	34	—	—	1908	do	do	Gravel	—	90	—	At Curves	—	do	6	95	do	—	—	——	do
9.3	—	—	—	48	—	—	1910	do	do	do	—	90	—	All	—	do	4	44	do	—	—	——	do
9.4	—	—	—	60	—	—	1909	Lucas West	do	Cedars Gravel Gravel Clay	—	88-90	—	Yes	—	do	5	82.6	do	—	—	——	do
9.5	—	—	—	29	—	—	1910	do	do	Lyons Stone	—	90	—	do	—	do	4	25	do	—	—	——	do
9.6	—	—	—	100	—	—	1902	Seymour, Tex.	G.C.&S.F.	Sand	Poor	60	Cut	None	Heavy	1904	2	100	—	—	—	Started to Rail 1904	11.00
	ZINC CHLORIDE																						
10.1	—	—	Seasoned	1274	—	0.5	1909	Fulton Ky	I.C.	Gravel	—	90	—	1 Double Shoulder	—	1913	4	0	—	Good	—	Continuous angle bars	12.00
10.2	—	—	do	274	—	do	do	Lake Miss	do	New Gravel	—	95	—	1 Double Shoulder	—	do	4	—	—	—	—	Damaged by drawbeard 40" Tubular bars	do
10.3	—	—	do	274	—	do	1910	Greenville Miss.	do	Dirt	—	95	—	1 Double Shoulder	—	do	3	0.73	Broken	Good	—	Weber Joints	do
10.4	—	—	do	274	—	do	1909	Kankakee Ill.	do	Old Rock	—	90	—	do	—	do	4	—	—	do	—	Continuous angle bars	do
10.5	—	—	do	274	—	do	1910	Bloomington, Ill.	do	Old Gravel	—	95	—	1 Double Shoulder	—	do	3	0	—	do	—	Weber Joints	do
	ZINC CHLORIDE - BURNETT																						
11.1	—	—	—	70	—	0.5	1909	Lucas East	C.B.&Q.	Cedars Gravel Gravel Clay	—	7-8"	—	Partly	—	1914	5	2.8	—	—	—	——	5.00
11.2	—	—	—	50	—	do	1910	do	do	Gravel	—	90	—	All	—	do	4	0	—	—	—	10% decayed	5.00
11.3	—	—	—	43	—	do	1909	Lucas West	do	Cedars Gravel	—	88-90	—	Yes	—	do	5	9	Slight Rail	—	—	2% Split	do
11.4	—	—	—	30	—	do	1910	do	do	Lyons Stone	—	90	—	do	—	do	4	0	—	—	—	——	do
11.5	—	—	—	100	—	0.35	1908	Seymour Tex.	G.C.&S.F.	Sand	Poor	60	Cut	None	Heavy	1911	9	100	—	—	—	——	11.00

@ Preliminary Creosote 8# @ 100 lb. Per Sq. Yard - Final Creosote 12# @ 100 lb. Per Sq. Yard

12.1	—	—	—	50	—	25 Sticks 20 Lbs	1908	Beaumont, Tex.	G.C. & S.F.	Sand	Poor	60	Cut	None	Heavy	1911	9	100	—	—	—	2% used for fuel	11.00
12.2	—	—	—	57	—	do	do	do	do	do	do	60	do	do	do	do	9	100	do	—	—	do 1 used	do
	ZINC CREOSOTE - CARD																						
13.1	—	—	—	160	—	25 & 33 20 Lbs	1908	Lower Miss'l	C.B. & Q.	Gravel	—	90	—	Gn Curves	—	1910	6	67	Packed	—	—		5.00
13.2	—	—	—	436	—	do	1909	do	do	Gravel & Sand Mixed	—	90	—	Partly	—	do	5	82	Split	—	—		do
13.3	—	—	—	492	—	do	1910	do	do	Gravel	—	90	—	All	—	do	4	0	—	—	—	5% damaged 1914 Split	do
13.4	—	—	—	267	—	do	1907	Lower Miss'l	do	Gravel & Sand Mixed	—	80-90	—	No	—	do	5	0	—	—	—	2% burned	do
13.5	—	—	—	121	—	do	1910	do	do	Levee Shore	—	90	—	do	—	do	4	83	Not Packed	—	—		do
	ZINC TANNIN - WELLHOUSE																						
14.1	—	—	—	100	—	0.33	1908	Beaumont, Tex.	G.C. & S.F.	Sand	Poor	60	Cut	None	Heavy	1912	10	95	—	—	—	Started to fail 1911	10.00

TABLE 25 PINE LODGEPOLE

	CREOSOTE - FULL CELL																				
1.1	—	—	Well Seasoned	39	—	8.841	1905	Ekborg, Mo.	C.B. & Q.	—	—	—	—	Sellers	—	1916	8.5	0	—	—	—	Treated 2½ yrs after Laying	5.10
	CREOSOTE - FULL CELL - LOWRY - RUBPING - See RED FIR Index No. 2.1																				
2.1	—	—	—	58	—	—	1907	Shoshone Wyo.	do	Bellefourche Gravel	—	85	—	do	—	1912	5.5	0	—	Good	—		5.00
	CREOSOTE - RUBPING																				
3.1	—	—	Well Seasoned	25	—	4.92	1905	Ekborg, Mo.	do	—	—	—	—	do	—	1914	8.5	0	—	—	—	Treated 2½ yrs after Laying	5.10
	UNTREATED																				
4.1	6'-6"-8'-0"	Mixed	Unpeeled Butts Only	15	—	—	1910	Redwood Woods	N.W.P.R.	—	Good	—	Cut	—	Light	1914	4	0	—	Good	—	15% partly decayed	41.00
4.2	—	—	Well Seasoned	10	—	—	1905	Ekborg, Mo.	C.B. & Q.	—	—	—	—	Sellers	—	do	8.5	40	Loosely Packed	—	—	Treated 2½ yrs after Laying	5.10
	ZINC CHLORIDE - BOILED																				
5.1	—	—	Peeled and Butts Well Painted	61	—	.35 - .40	1904	Shoshone Wyo.	do	Bellefourche Gravel	Poor	85	—	do	Heavy	do	9	100	Packed Indiscriminately	—	2.7	34% out in 1912	5.00
	ZINC CHLORIDE - BURNETT																				
6.1	—	—	—	1996	—	—	1906	do	do	—	—	—	—	—	—	do	8	15	Burned	Good	—		5.00
6.2	—	—	Well Seasoned	63	—	.309	1905	Ekborg, Mo.	do	—	—	—	—	Sellers	—	do	8.5	30	Decay	—	—	Treated 2½ yrs after Laying	5.10
	ZINC CREOSOTE - ALLAROYCE																				
7.1	—	—	Well Seasoned	77	—	4.50 Lbs Zinc 1.62 Lbs Creo	do	do	do	—	—	—	—	do	—	do	8.5	2.6	—	—	—	do	do

PINE LONGLEAF

	CREOSOTE																				
8.1	—	—	—	250	—	—	1887	North Carolina	A.C.L.	Sandy Loam	—	—	—	—	—	1908	23	40	Not Cut	Good	—		53.00
8.2	—	—	—	—	—	15	do	N.Y. City	N.Y. City (Yonkers)	—	—	—	—	—	—	1908	21	0	—	—	—	Removed 1908 To make room for N. Shore Tunnel	37.00
8.3	—	—	Green Removed Bark after Felled	300	—	8	1910	Beaumont, Tex.	G.L. & S.F.	—	—	—	—	—	—	1914	4	0	—	—	—		30.10
8.4	—	—	Peeled Butts Only Well Painted	300	—	8	do	do	do	—	—	—	—	—	—	do	4	0	—	—	—		do
8.5 @	—	—	—	—	—	12	1897-9	Dallas to Arcadia	D.L. & W.	Bridges	—	—	—	—	—	do	6-9	—	—	—	Edges	Shelled - Piled by steam power & burned Steam drill cutter does holes	1-26
8.6	—	—	—	—	—	12	1906	do	do	do	—	—	—	Yes	—	do	8	100	Creosoted under Pressure	—	—	Shelled in cool weather does holes Sawed in cool weather after Seasoning	do
	OIL BEAUMONT																				
9.1	—	—	—	100	5.67	3	1908	Beaumont, Tex.	G.C. & S.F.	Sand	Poor	60	Cut	None	Heavy	1911	9	100	—	—	5	70% removed 1906	11.00
	OIL AND ZINC CHLORIDE																				
10.1	—	—	—	108	5.0	—	do	do	do	do	do	60	do	do	do	1912	10	0	—	—	—	Started to fail 1911	do
	SALTS - BARSCHALL HASSELMANN																				
11.1	—	—	—	100	—	—	do	do	do	do	do	60	do	do	do	do	10	95	—	—	6	do 1908	do
	SPIRITTINE																				
12.1	—	—	—	100	—	3.3	do	do	do	do	do	60	do	do	do	do	10	85	—	—	6.7	Started to fail 1906 All removed 1908	do
	UNTREATED																				
13.1	—	—	—	93	—	—	1902	do	do	do	do	60	do	do	do	1911	9	100	—	—	—	All removed 1906	do
13.2	—	—	—	2100	—	—	1900	Ark. Misc.	C.R.I. & P.	Gravel	—	85	—	do	—	1915	14-15	87	Decayed & Rotten	—	—	Done out by 1911	6.00
13.3	9'-6"-8'	—	—	99	—	—	1910	Ensley Ala.	S.C.M.R.Co.	—	—	—	—	Gn Curves	—	1914	4	7	—	—	—	15% Good - All Bad Decay 35% decayed	21.00

@ Avg. life estimated by Forest Service

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	WOODLINE - DIPPED																						
14.1	—	—	—	75	1.33 Gal	—	1897	—	Mill at Ry	—	—	—	—	Yes	—	1899	2	0	—	Good	—	—	2.00
	WOODLINE - PAINTED (NOT)																						
15.1	—	—	—	150	—	—	do	—	do	—	—	—	—	do	—	do	2	0	—	do	—	—	do
	ZINC CHLORIDE - BOILED																						
16.1	—	—	—	6	—	—	1902	Sacramento Ry.	G.C. & S.F.	Sand	Poor	80	Cut	None	Heavy	1912	10	17	—	—	—	Started to Fail 1911	11.00
	ZINC CHLORIDE - BURNETT																						
17.1	8'-0" to 8'-6"	Sand	—	57	—	—	1901	Pennsylvania Coal	A.T. & S.F. Ry.	Shore	Open Creek Bottom	100	do	Salt Water	—	1914	13	100	Decay	—	13	—	3.00
17.2	do	do	—	68	—	—	do	do	do	do	do	do	do	do	—	do	do	20	do	—	—	Expect Removal 15% in 1915 Removal 1916	do
17.3	do	do	—	67	—	—	do	do	do	do	do	do	do	do	—	do	do	0	—	—	—	do 9% do do 1916	do
17.4	do	do	—	14	—	—	do	do	do	do	do	do	do	do	—	do	do	100	Decay	—	—	—	do
	ZINC CREOSOTE - ALLAROYCE																						
18.1	—	—	—	30	—	1/4 Zinc 3/4 Creo.	1902	Sacramento Ry.	G.C. & S.F.	Sand	Poor	60	Cut	None	Heavy	1912	10	14	—	—	—	Started to Fail 1908	11.00
	ZINC CREOSOTE - BEAUMONT																						
19.1	—	—	—	50	—	0.33 Zinc 0.67 Creo.	do	do	do	do	do	60	do	do	do	do	10	40	—	—	—	38% removed 1908	do
	ZINC TANNIN - WELLHOUSE																						
20.1	—	—	—	180	—	0.33	do	do	do	do	do	60	do	do	do	do	10	35	—	—	—	55% removed 1908	do
	PINE - MOUNTAIN																						
	OIL, BAKERSFIELD																						
21.1	—	—	—	2	—	—	1902	Sacramento Ry.	G.C. & S.F.	Sand	Poor	60	Cut	None	Heavy	1912	10	0	—	—	—	—	11.00
21.2	—	—	—	3	—	—	do	do	do	do	do	60	do	do	do	do	10	87	—	Good	—	Taken out for inspection	do
	OIL, BAKERSFIELD AND ZINC CHLORIDE - BURNETT																						
22.1	—	—	—	8	—	—	do	do	do	do	do	60	do	do	do	do	10	0	—	—	—	—	do
	ZINC CHLORIDE - BURNETT																						
23.1	—	—	—	10	—	0.33	do	do	do	do	do	60	do	do	do	do	10	20	—	—	—	Started to Fail 1908	do
23.2	—	—	—	—	—	0.33-0.67	do	New Mex. Dr.	A.T. & S.F.	Soil or Shore	—	—	—	—	—	—	—	—	—	—	4%	4° Curve	2.00
23.3	—	—	—	30.5	—	—	1885	Topeka Kas.	do	—	—	—	—	—	Heavy	1915	11	0.7	Spike Rot	—	—	do	do
	ZINC TANNIN - WELLHOUSE																						
24.1	—	—	—	—	.78	—	1896	West	U.P.	—	—	—	—	—	—	1898	12	—	—	—	8	Practically all out 1914	do
24.2	—	—	—	—	do	—	do	do	do	—	—	—	—	—	—	do	12	—	—	—	8.5	do 1895	do
24.3	—	—	—	—	do	—	do	do	do	—	—	—	—	—	—	do	12	—	—	—	9	do 1898	do
	PINE - PITCH																						
	WOOD TAR CREOSOTE																						
25.1	—	—	—	1	do	—	1889	Washington D.C.	U.S. System	—	—	—	—	—	—	1914	—	100	—	—	8	Worn out	20.10
	PINE - RED NORWAY																						
	ZINC TANNIN - WELLHOUSE																						
26.1	—	—	Seasoned 6 mo	86	—	—	1890	—	Dr. I.M.	Gravel	Good	60	Cut	—	Light	1908	18	100	—	—	15	Piled on light side of double bank	22.00 33.10
	PINE - RIGA																						
	UNTREATED																						
27.1	4.5" - 9"	—	—	—	—	—	—	Denmark	Hempel Asbury	—	—	—	—	—	—	—	7	57	—	—	—	—	9.00
	PINE - SAP																						
	COPPER AND IRON SULPHATE - BOUCHERIE																						
28.1	—	—	—	1000	—	—	1869	Tunnel N. Hamburg	Hamburg Meuse R.R.	—	Poor	—	—	—	Heavy	1888	18	—	—	—	—	Process too tedious	2.90
	DIAMOND WOOD PRESERVATIVE																						
29.1	7"-9"-10"	Mixed	—	500	0.4 Gal	0.1 Gal	1909	N. Hamburg and Ldn. Ry.	B.W.P.S.A.	Slag	—	—	Cut	Abandoned	—	1914	25	0	—	Good	—	Process bad - last only few years	2.00
	ZINC CHLORIDE - BURNETT																						
30.1	—	—	—	1644 759	—	—	1905	—	T.P.R.T. System	—	—	—	—	—	—	1907	6	0.4	—	—	—	Changed to Hamburg	1.00

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30.5	5'0"x6'0"	Hollow	Seasoned	550	4 cells	6 at 12 lbs	1900	Southern R.R.	S.W.U.S.A.	—	—	—	—	Absorbed	—	1910	9	10.0	—	—	5.0	Re-treated in 1910 by A.L. Stevens	7.00
30.6	do	do	do	550	do	do	do	do	do	—	—	—	—	None	—	do	9	10.0	—	—	5.6	do do	7.00
	ZINC CREOSOTE																						
31.1	5'0"x6'0"	None	—	550	144 cells 20 Gross	0.375 lbs. 0.44 Oxide	do	Ashley Mo.	do	—	—	—	Some	—	—	do	9	10.0	—	—	—	Creosoted Sap. after butt-treatment	do
31.2	do	do	—	136	do	do	do	do	do	—	—	—	—	Absorbed	—	do	9	6.9	—	—	—	do	do
31.3	do	do	—	137	do	do	do	do	do	—	—	—	—	None	—	do	9	10.2	—	—	8.3	re-treated by Forest Service	do
	ZINC TANNIN - WELLHOUSE																						
32.1	—	—	—	1,300,612	—	—	1901	—	M.P.R.R. System	—	—	—	—	—	—	1907	6	22	—	—	—	Changed to Burnettizing	1.00
										PINE SHORTLEAF													
	CREOSOTE																						
33.1	—	—	—	2494	2.5 Gal	—	1907	Swis. ohio	B. Yellow	—	—	—	—	—	—	1918	5	—	—	—	—	———	30.00
33.2	—	—	Seasoned Some Sapwood Treated	300	—	8	1910	Belleville, Ark.	M.L.V.S.W.	—	—	—	—	—	—	1914	4	0	—	Good	—	———	30.10
33.3	—	—	Seasoned Some Sapwood Treated	268	—	8	do	do	do	—	—	—	—	—	—	do	4	0	—	do	—	———	30.10
33.4	—	—	—	5000	—	12.0	1879	—	C.R.I.&P.R.R.	—	—	—	—	—	—	1908	—	—	—	—	15.5	Coarse grain from Pine Bluff only all removed 1918	1.00
	CREOSOTE - DIPPING																						
34.1	—	—	—	41900	—	—	1907	Iowa	C.M.St.P.R.	—	—	—	—	Yes	—	do	7	—	—	Partial	—	———	6.10
	CREOSOTE - STEAMING																						
35.1	5'0"x6'0"	—	Seasoned some sapwood	69 000	5 gal	1.17 Gal	1880	Hamilton Tex	M.K.T.R.R.	—	—	—	—	—	—	1892	8	0	—	Sound	—	L. Fe. not treated 85 yrs.	2.40
	CREOSOTE COAL TAR - FULL CELL																						
36.1	—	—	—	—	—	10	1890	Hampton and Yorkville	Thomas	—	—	—	—	—	—	—	—	—	—	—	—	Many Sound after 23 yrs. service	35.00
	CRESOL CALCIUM																						
72.1	5'0"x6'0"	—	Well Seasoned	104	—	1.15	1910	Alabama	I.C.I.R.R.Co.	—	—	—	—	Gabbis	—	1914	4	5	—	—	—	40% Good - 60% Partly decayed	2.00
@72.2	do	—	do	102	—	0.85	do	do	do	—	—	—	—	do	—	do	4	7	—	—	—	———	do
@72.3	do	—	do	101	—	0.51	do	do	do	—	—	—	—	do	—	do	4	20	—	—	—	15% Good - 25% Good decayed - 60% decayed	do
72.4	do	—	do	93	—	0.27	do	do	do	—	—	—	—	do	—	do	4	30	—	—	—	5% do 15% do 80% do	do
	OIL BAKERSFIELD																						
38.1	—	—	—	4	—	—	1902	Beaumont Tex.	R.E.N.S.R.	Sand	Poor	60	Dark	None	Heavy	1912	10	25	—	—	—	One end Sap - no protection	11.00
	SALTS BARSCHALL HASSELMANN																						
39.1	—	—	—	98	—	—	do	do	do	do	do	60	do	do	do	do	10	99	—	—	4.9	75-5% out 1906 - 37% out 1908 Rep. by A.L. & Stevens by Forest Service	do
	UNTREATED																						
40.1	—	—	—	100	—	—	do	do	do	do	do	60	do	do	do	1906	4	100	—	—	5.4	35.5% out in 1914 re. T.I.S. by Forest Service	do
	ZINC CHLORIDE - BOILED																						
41.1	—	—	—	4	—	—	do	do	do	do	do	60	do	do	do	1912	10	25	—	—	—	25% removed 1908	do
	ZINC CHLORIDE - BURNETT																						
42.1	—	—	—	3	—	—	do	do	do	do	do	60	do	do	do	do	10	67	—	—	—	67% removed 1906	do
42.2	—	—	—	100	—	0.75	do	do	do	do	do	60	do	do	do	do	10	82	—	—	—	61% do 1908	do
42.3	—	—	Not seasoned	60428	6.25 Gross - 0.50 0.3 Zn Cl 0.2 Zn Ox 0.75 Zn Ox		1899-11	Glidden Dist	S.R.	Gravel	Sand 4 Clay	61.5	—	—	—	1910	7-13	100	Ref. 82.16	—	6.75	Life extended - Sound 4.5 yrs. Affected Sand 6-9 yrs	2.50 3.00
42.4	—	—	do	41691	do	do	do	Sabine Dist	do	do	do	4 30"	do	—	—	do	4	4	4	11 88%	8.16	do	do
42.5	—	—	do	15584	do	do	do	Calcasieu Dist	do	do	do	4 12"-28"	50	—	—	do	4	4	4	do 98%	8.87	do	do
42.6	—	—	do	2609	do	do	do	Anderson Dist	do	Sand	do 4 10"-18"	58-68	—	—	—	do	4	4	4	do 66%	8.67	do	do
42.7	—	—	do	13899	do	do	do	Nacogdoches Dist	do	10% Fine Gravel	do 10"-14"	58-70	—	—	—	do	4	4	4	do 95%	9.00	do	do
42.8	—	—	do	19397	do	do	do	Ft Pine Dist	do	None	do 8-10"	61.5	—	—	—	do	4	4	4	do 21%	7.50	do	do
42.9	6'0"x6'0"	—	—	500	—	0.5	1906	Herndon S.D.	A.M.&M.R.	Gravel	fair	85	Cut	Mottled	—	1910	0	10.0	Not	Good	—	None removed before 1910	6.10
42.10	do	—	—	500	—	do	1903	Washington Tex	do	do	Good	85	do	Mod. to Heavy	—	1915	12	10.0	do	do	—	do 1913	do
	ZINC CREOSOTE																						
43.1	—	—	—	50	—	0.5 Zn Cl Creosote	1902	do	do	do	—	85	—	do	—	do	10	86	—	—	—	86% removed 1906	11.00
43.2	—	—	—	—	—	0.25 Zn Cl Creosote	1905	—	S.L.V.S.W.	—	—	—	—	—	—	1908	3	—	—	—	—	———	1.00

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	ZINC CREOSOTE - ALLARDYCE																						
44.1	—	—	—	50	—	2x4 Ends 6 to Cord	1902	Claremont, Va.	C.C. & S.F.	Sound	Poor	60	Cut	None	Heavy	1912	10	44	—	—	—	48% removed in 1908	11.00
	ZINC TANNIN - WELLHOUSE																						
45.1	—	—	—	100	—	0.83	do	do	do	do	do	60	do	do	do	do	10	60	—	—	—	79% removed in 1908	do
45.2	6'-8"-8'	—	—	500	—	—	1903	Washington, D.C.	B.M. & E.R.	—	—	65	—	Treated 1910	—	1914	11	10	Rot	—	—	———	6.10
												PINE - SWEDISH												
	UNTREATED																						
46.1	6½"-8½	—	—	18000	—	—	—	Denmark	Specified Local Inspection by Agt.	—	—	—	—	—	—	—	9	72	—	—	7.5	Avg. life estimated by Forest Service	9.00
46.2	do	—	—	60000	—	—	—	do	do	—	—	—	—	—	—	—	12	48	—	—	—	———	do
46.3	do	—	—	47000	—	—	—	do	B.C. Co's	—	—	—	—	—	—	—	9	47	—	—	—	———	do
46.4	8"-10"	—	—	10000	—	—	—	do	Hall, Inc.	—	—	—	—	—	—	—	16	80	—	—	10.6	Avg. life estimated by Forest Service	do
46.5	6½"-8½"	—	—	56300	—	—	1896	do	M. Howard	—	—	—	—	—	—	1909	13	74	—	—	10.0	do	do
46.6	do	—	—	84000	—	—	—	do	Adirondack	—	—	—	—	—	—	—	11	73	—	—	8.0	do	do
46.7	do	—	—	10000	—	—	—	do	Hall Lumber	—	—	—	—	—	—	—	11	96	—	—	7.0	do	do
46.8	6"-8"	—	—	48000	—	—	—	do	Long Lbr. Co. Va. & Carolina	—	—	—	—	—	—	—	11	45	—	—	—	———	do
46.9	6"-8"	—	—	40000	—	—	—	do	Va. & Carolina	—	—	—	—	—	—	—	13	43	—	—	—	———	do
												PINE - VIRGINIA												
	CREOSOTE — HAYFORD																						
47.1	—	—	Seasoned Sawed Ends	10000	—	—	1906	Round Brook	C.R. of N.J.	—	—	—	—	—	—	1908	8	0	—	Sound	—	Slight rail cutting	2.40
47.2	—	—	—	10000	—	—	1908	do	P.R.R.	—	—	—	—	—	—	1922	4	0	—	O.K.	—	Favorable	do
												PINE - WHITE												
	SULPHATE OF COPPER OR ZINC AND BARNETT CHLORIDE - THILMANY																						
48.1	—	—	—	1006	—	—	1881	Washington Conn.	W.R.R. & H.	Stone	—	To be renewed 1916	Cut	—	—	1896	15	100	—	—	11-15	———	38.00
	UNTREATED																						
49.1	—	—	—	—	—	—	—	—	C.B. & Q.	—	—	—	—	—	—	—	—	—	—	—	5	10% Renewal due to decay	38.00
	ZINC TANNIN - WELLHOUSE																						
50.1	—	—	Seasoned Ends	85	—	—	1910	—	O. & P. Ry.	Gravel	Good	80	Cut	—	Light	1908	18	100	Fire Broken	—	10 / 15	Road changed & double track from Embankment has applied in front the Light Traffic	28.10 32.00
												PINE - YELLOW												
	CREOSOTE																						
51.1	—	—	—	—	—	—	1898	New York City	Grand Trunk	—	—	—	—	—	Heavy	1900	16	—	—	Perfect	—	Rebuilt 1900	28.50
51.2	—	—	—	8000	—	12	1907	—	D.L. & W.	—	—	—	—	Yes	—	1914	7	100	Smashing Under Repair	—	—	———	28
51.3	—	Bridge Ties	—	12000	—	12	1905	Buffalo, N.Y.	do	—	—	—	—	do	—	do	9	100	—	—	—	added by showing present to heart wood	do
	TEREDO PROOF PAINT																						
52.1	—	—	—	—	—	—	1899	—	Phila. Sch. Dy.	—	—	—	—	—	—	1907	8	—	—	Good	—	———	38.00
	UNTREATED																						
53.1	—	—	—	7500	—	—	1900	Iowa	C.R.I. & P.	—	—	—	—	—	—	1910	10	41.8	—	—	—	———	1.10
53.2	—	—	—	M608	—	—	1903	N.Y.	N.Y.C. & H.R.	—	—	—	—	—	—	do	7	123	—	—	—	———	do
53.3	—	—	—	21805	—	—	1901	PENN	P.R.R.	—	—	—	—	—	—	1914	13	43	—	—	—	———	2.25 2.75
	See CHESTNUT Index No. 3.3																						
	See OAK Index No. 4.3																						
	See WHITE OAK Index No. 5.5 & 5.8 Anal.																						
												PINE - GEORGIA YELLOW												
	WOOD TAR CREOSOTE																						
54.1	—	—	—	96	—	—	1897	Baltimore, Md.	Pa. System	—	—	—	—	—	—	1904	—	100	Creosoted	—	7	———	28.10
	WOOD TAR CREOSOTE - BRUSH																						
55.1	—	—	—	42	—	—	1910	do	do	—	—	—	—	—	—	do	—	100	Decay	—	10	———	do
												PINE - SOUTHERN YELLOW												
	ARSENATE																						

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5E.2	7'6"×8'-0"	Hewn	—	500	—	—	1905	Northern Pac.	Stanton	Shore	Piling	100	—	—	—	1914	—	—	—	—	—	Replaced 1914	2.50
CREOSOTE COAL TAR - CARD EMULSION																							
5F.1	—	—	—	500	—	—	1901	Illinois Pac.	Mt. System	—	—	—	—	—	—	do	—	100	—	—	9.0	Record not complete	20.10
5F.2	—	—	—	250	—	—	do	Mahoney Pit	do	—	—	—	—	—	—	do	—	100	Extended	—	7.5	do	do
5F.3	—	—	—	125	—	—	do	Seaside Rd.	do	—	—	—	—	—	—	do	—	100	4/5 decay	—	9.0	do	do
5F.4	—	—	—	125	—	—	do	do	do	—	—	—	—	—	—	do	—	100	—	—	10.00	Good condition 1911	do
5F.5	—	—	—	125	—	—	do	Shrewsbury Rd.	do	—	—	—	—	—	—	do	—	100	Mahoney	—	10.0	Record not complete	do
5F.6	—	—	—	125	—	—	do	do	do	—	—	—	—	—	—	do	—	100	—	Good	10.0	Good condition 1911	do
PINE - WESTERN YELLOW																							
UNTREATED																							
5G.1	6"×6"×8'-0"	Hewn	Unevenly Trimmed Top	15	—	—	1910	Edmond Wash.	M.K.&N.	—	Good	—	Cut	Hewn	Light	1914	4	0	—	Good	—	3 Perfectly decayed	41.00
TABLE 26 - POPLAR																							
CREOSOTE - FULL CELL																							
L1	—	—	—	30	—	—	1910	Hanover, Ill.	C.B.&Q.	Glendon Coal	—	90	—	All	—	1912	2	0	—	—	—	———	5.00
L2	—	—	—	20	—	—	do	Glenday, Ill.	do	do	—	90	—	10's	—	do	2	0	—	—	—	———	do
L3	—	—	Trimmed 1/2 of Top Treated	30	—	—	do	Barr Calo	do	Lyons Shore	Hog Bay	90	—	do	—	do	2	0	—	—	—	———	do
COPPER SULPHATE - BOUCHERIE																							
L1	—	—	—	—	—	—	1857	Chil. S.A.	Southern Ry	—	—	—	—	—	—	1860	3	—	—	—	—	Permeable	2.40
UNTREATED																							
L1	—	—	—	55	—	—	1909	Lewis Point	C.B.&Q.	Cedar Island Coal Dock	—	70-85	—	Partly	—	1914	5	70.0	Rot	—	—	———	5.00
L2	—	—	—	25	—	—	1910	do	do	Brevel	—	90	—	All	—	do	4	31.8	do	—	—	———	do
L3	—	—	—	34	—	—	1909	Lewis Point	do	Cedar Island Coal Dock	—	85-90	—	10's	—	do	5	65.4	do	—	—	———	do
L4	—	—	—	15	—	—	1910	do	do	Lyons Shore	—	90	—	do	—	do	4	15.0	do	—	—	———	do
WOOD TAR CREOSOTE																							
M.1	—	—	—	17	—	—	1908	Mich. Central	Mt. System	—	—	—	—	—	—	1914	—	100	Decay	—	5	Record not complete	20.10
ZINC CHLORIDE - BURNETT																							
S.1	—	—	—	30	—	0.5	1910	Hanover Ill	C.B.&Q.	Glendon Coal	—	90	—	All	—	1914	4	10	Rot	—	—	15% split	5.00
S.2	—	—	—	20	—	do	do	Glenday Ill	do	do	—	90	—	do	—	do	4	5	Split	—	—	———	do
S.3	—	—	Trimmed 1/2 of Top Treated	30	—	do	do	Barr Calo	do	Lyons Shore	Hog Bay	90	—	10's	—	1912	2	0	—	—	—	———	do
ZINC CREOSOTE - CARD																							
G.1	—	—	—	166	—	1/2 Zinc 1/2 Creo	1909	Lewis Point	do	Cedar Island Coal Dock	—	70-85	—	Partly	—	1914	5	9.5	Split	—	—	———	do
G.2	—	—	—	20	—	do	1910	do	do	Brevel	—	90	—	All	—	do	4	0	—	—	—	4% Split	do
G.3	—	—	—	208	—	do	1909	Lewis Point	do	Cedar Island Coal Dock	—	85-90	—	10's	—	do	5	3.4	Split	—	—	———	do
G.4	—	—	—	46	—	do	1910	do	do	Lyons Shore	—	90	—	do	—	do	4	0	—	—	—	———	do
TABLE 27 - REDWOOD BALTIC																							
CREOSOTE - FULL CELL																							
A1	5'-6"×8'-0"	Sawed	Eliminated by Sawing of Logs	—	—	1 gal	—	Copland	Bidwell's Point Ferry	—	—	Hilltop Type	Stiff	—	—	—	—	—	Split	—	15	———	2.20
A2	do	do	do	—	—	0	—	do	Pennsylvania	—	—	do	do	—	—	—	—	—	—	—	15	40000 Annual renewals	do
A3	do	do	do	—	2.5 Gal	0	—	do	Mt. Tamalpais	—	—	do	do	—	—	—	—	—	—	—	—	6000 to 24000 do	do
A4	do	do	do	—	do	—	—	do	Mt. Tiburon	—	—	do	do	—	—	—	—	—	Wear	—	10-15	30000 to 40000 do	do
A5	do	do	do	—	—	0.7 Gal	—	do	Mt. Mattoon	—	—	do	do	—	—	—	—	—	—	—	—	———	do
A6	do	do	do	—	30	—	—	do	L.V.R.W.	—	—	do	do	—	—	—	—	—	Wear	—	10-20	500 000 Annual renewals	do
A7	do	do	do	—	2.5 Gal	—	—	do	L.V.S.W.	—	—	do	do	—	—	—	—	—	Part-split	—	12	170 000 do	do
A8	do	do	do	—	—	7 B/D	—	do	L.T.V.S.	—	—	do	do	—	Light	—	—	—	Decay	—	25-30	———	do
A9	do	do	do	—	—	10	—	do	regulation 3rd	—	—	do	do	—	—	—	—	40	do	—	16	20 per mile 40% decay	do
A10	do	do	do	—	20	—	—	do	Mt. Lassen	—	—	do	do	—	—	—	—	—	—	—	15	———	do
A11	do	do	do	—	30	—	—	do	Mt. Shasta	—	—	do	do	—	—	—	—	—	Wear	—	8-9	99000 Annual renewals	do
A12	do	do	do	—	—	1.25 Gal	—	do	Mt. Tam	—	—	do	do	—	—	—	—	—	—	—	15	12 000 do	do

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
2.1	ZINC CHLORIDE —	—	—	—	—	—	—	Mississ	Mississippi	—	—	—	—	—	—	—	—	—	—	—	8	Life unbroken 4 yrs	$8.20
												REDWOOD - CALIFORNIA											
	CARBOLINEUM - AVENARIUS																						
3.1	—	—	—	1000 Gal Mixt	—	—	1905	Hawaii	Honolulu Harbor Board	—	—	—	Steam	Complete	—	1913	10	0	—	—	—	Am Cal R. Redwood - unmodified condition	$9.00
	OIL, CALIFORNIA AND ZINC CHLORIDE																						
4.1	—	—	—	2	—	—	1902	Beaumont Tex	G.C. & S.F.	Sand	Poor	60	Cut	None	Heavy	1905	3	100	—	—	—	Shorted to Fail 1905	$100
	ZINC CHLORIDE - BURNETT																						
5.1	—	—	—	8	—	0.35	do	do	do	do	do	60	do	do	Ice	do	3	100	—	—	—	do	do
												SPRUCE											
	CREOSOTE - FULL CELL																						
6.1	10-10"	Sound	Green	—	—	—	1860	Mass.	B & A	—	—	—	—	—	Heavy	1869	9	100	Split	—	—	—	$2.40
	MERCURIC CHLORIDE - KYAN																						
7.1	6'-8"	—	Seasoned 6 to 8 mo.	35	—	—	1911	Hartford Ills	C.R.I. & P.	Gravel	Good	90	4 to 6 Years	10% metal 90% creosote	Heavy	1916	3	3	—	—	—	—	$9.00
See	PINE Index No 11.1																						
	UNTREATED																						
See	cedar Index No 4.6																						
	ZINC CHLORIDE - BURNETT																						
9.1	—	—	—	—	—	—	1855	Mass	Union	—	—	—	—	—	Light	1883	30	—	—	Good	—	Horse car tracks	2.40
												TABLE 28 - SYCAMORE											
	CREOSOTE - FULL CELL																						
1.1	—	—	—	45	—	—	1910	Hanover Ill	C.B.&Q.	Meridian Gravel	—	90	—	All	—	1912	2	0	—	—	—	—	5.00
1.2	—	—	—	30	—	—	do	Blandinsville Ill	do	do	—	90	—	do	—	do	2	0	—	—	—	—	do
1.3	—	—	Seasoned 1 yr after treatment	15	—	—	do	Barr, Colo.	do	Lyons Stone	Very Dry	90	—	Nos	—	do	2	0	—	—	—	—	do
	UNTREATED																						
2.1	—	—	—	65	—	—	1909	Lines East	do	Quaker Gravel Burnt Clay	—	90 & 75	—	Partly	—	1914	5	85.0	—	—	—	—	do
2.2	—	—	—	35	—	—	1910	do	do	Gravel	—	90	—	All	—	do	4	80.0	—	—	—	—	do
2.3	—	—	—	35	—	—	1909	Lines West	do	Quaker Gravel Burnt Clay	—	80-90	—	Nos	—	do	5	90.0	—	—	—	—	do
2.4	—	—	—	15	—	—	1910	do	do	Lyons Stone	—	90	—	do	—	do	4	85.0	—	—	—	—	do
	ZINC CHLORIDE - BURNETT																						
3.1	—	—	—	45	—	0.5	1910	Hanover Ill	do	Meridian Gravel	—	90	—	All	—	1912	2	0	—	—	—	—	do
3.2	—	—	—	30	—	do	do	Blandinsville Ill	do	do	—	90	—	do	—	do	2	0	—	—	—	—	do
3.3	—	—	Injected for color treatment	15	—	do	do	Barr, Colo.	do	Lyons Stone	Very Dry	90	—	do	—	do	2	0	—	—	—	—	do
	ZINC CREOSOTE - CARD																						
4.1	—	—	—	175	—	0.5 to 2.00	1909	Lines East	do	Quaker Gravel Burnt Clay	—	90 & 75	—	Partly	—	1914	5	69	Split	—	—	—	do
4.2	—	—	—	224	—	do	1910	do	do	Gravel	—	90	—	All	—	do	4	0	—	—	—	—	do
4.3	—	—	—	91	—	do	1909	Lines West	do	Quaker Gravel Burnt Clay	—	80 & 75	—	do	—	do	5	28	Split	—	—	—	do
4.4	—	—	—	30	—	do	1910	do	do	Lyons Stone	Very Dry	90	—	do	—	do	4	0	—	—	—	—	do
												TABLE 29 - TAMARACK											
	CREOSOTE - FULL CELL																						
1.1	—	—	—	65	—	0.05	1909	Lines East	C.B.&Q.	Quaker Gravel Burnt Clay	—	90 & 75	—	Partly	—	1914	5	0	—	—	—	—	5.00
1.2	—	—	—	30	—	do	1910	do	do	Gravel	—	90	—	All	—	do	4	0	—	—	—	—	do
1.3	—	—	—	14	—	do	1911	do	do	do	—	75	—	Principally Cull Ties	—	do	3	0	—	—	—	—	do
1.4	—	—	—	46	—	do	1909	Lines West	do	Quaker Gravel Burnt Clay	—	80-90	—	Nos	—	do	5	0	—	—	—	—	do
1.5	—	—	—	60	—	—	1910	do	do	Lyons Stone	Very Dry	90	—	do	—	do	4	0	—	—	—	—	do

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	CREOSOTE - OPEN TANK																						
3.1	—	—	Vertical Seasoning	19	15.5	—	1907	Knoxville, Wis	C & N W	Gravel	Good	90	Cut	Hickory	Light	1913	7.5	0	—	Good	—	All sound	26.00
	SALTS - BARSCHALL HASSELMANN																						
3.1	—	—	—	98	—	—	1902	Brunswick Ga	S.F.Y.S.P.	Sand	Poor	60	Cut	Pine	Heavy	1911	6	100	—	—	4	80% removed 1905	11.00
	UNTREATED																						
4.1	—	—	—	—	—	—	1902	Brunswick Ga	S.F.Y.S.P.	Sand	Poor	60	Cut	Pine	Heavy	1905	3.5	100	—	—	—	All removed 1905	11.00
4.2	—	Hicks Cut	Pocket Seasoned 30 mo.	85	—	—	1907	Knoxville Wis.	C & N W.	Gravel	Good	90	do	do	Light	1915	7.5	32	Decay	Decay Limbs	6.9	Remainder partly decayed & rotten	26.00
4.3	—	—	Seasoned in Stacked 30 mo.	25	—	—	do	do	do	do	do	do	do	do	do	do	7.5	100	do	do	6.5	do	do
4.4	—	—	Pocket Seasoned 30 mo.	29	—	—	do	do	do	do	do	do	do	do	do	do	7.5	95	do	do	6.6	do	do
4.5	—	—	Seasoned in Stacked 60 mo.	82	—	—	do	do	do	do	do	do	do	do	do	do	7.5	98.4	do	do	6.5	do	do
4.6	—	—	—	9.500	—	—	1902	Hainesville	D.F.S.P.	—	—	—	—	—	—	1916	10	100	—	—	7-8	Treat bld and repl 8 All out 1912	5.10 1.25
4.7	—	—	—	85	—	—	1907	Lows East	C.B.Q.	Crushed Gravel Ballast Only	—	70-80 90	—	Butty	—	do	5	99.9	Rot	—	—	—	5.00
4.8	—	—	—	10	—	—	1910	do	do	Gravel	—	90	—	All	—	do	4	10	do	—	—	—	do
4.9	—	—	—	49	—	—	1909	Lows West	do	Crushed Gravel Gravel Chip	—	80-90	—	do	—	do	5	82.8	do	—	—	—	do
4.10	—	—	—	30	—	—	1910	do	do	Lyons Shore	—	90	—	do	—	do	4	15	do	—	—	—	do
4.11	—	—	—	2894	—	—	1908	Newport	G.N.	Gravel	Good	90	5/16"	H.P.H.Bl	—	do	6	51.9	do	—	—	5% of removed split & broken Includes Red Spruce & Fir	40.00
4.12	7'-8"x8'	—	—	2966	—	—	1904	Hubbell	do	Crushed Gravel	do	60	5/16"	H.P.H.&B	—	do	10	99.6	do	—	—	—	do
4.13	—	—	—	2168	—	—	1904-5	Fortbine	do	Gravel	do	97.5	do	Pine	—	do	10	100	Ref. on S.P. Bankers	—	7.4	Includes Red, Spruce & Fir	do
4.14	7'-8"x8'	—	—	2989	—	—	1908	Ashdale Cap	do	do	do	85	do	Red Pine Hickory and Oak	—	do	6	15.3	do	—	—	do	do
4.15	do	—	—	2916	—	—	do	Rimrock	do	do	do	90	3/16"	H.P.H.&B	—	do	6	18.4	do	—	—	do	do
	ZINC CHLORIDE - BURNETT																						
5.1	—	—	—	85	—	0.5	1909	Lows East	C.B.Q.	Crushed Gravel Gravel Chip	—	70-80 90	—	Butty	—	1914	5	1.3	Split	—	—	—	5.00
5.2	—	—	—	21	—	do	1910	do	do	Gravel	—	90	—	All	—	do	4	0	—	—	—	—	do
5.3	—	—	—	45	—	do	1909	Lows West	do	Crushed Gravel Gravel Chip	—	80-90	—	Pine	—	do	5	0	—	—	—	—	do
5.4	—	—	—	61	—	do	1910	do	do	Lyons shore	—	90	—	do	—	do	4	0	—	—	—	—	do
5.5	—	Youngdale	—	1320	—	0.45-0.5	1906	do	do	Hudson Rock	—	85	—	—	—	do	10.5	61.0	—	Pair	—	—	5.00 5.00
5.6	—	—	—	49	—	0.41	1902	Brunswick Ga	G.P.Y.S.P.	Sand	Poor	60	Cut	Pine	Heavy	1912	9.5	0	—	—	—	10% decayed	11.00
5.7	7'-8"x8'	—	—	2848	—	0.5	1905	Brunswick	G.N.	Crushed Gravel	Good	60	5/16"	do	—	1914	11	9.7	Rot	—	—	Includes Pine, Spruce & Fir	40.00
5.8	—	—	—	2580	—	do	do	Glenborn	do	do	do	do	do	do	—	do	11	8.2	do	—	—	—	do
5.9	—	—	—	2708	—	do	1906	White Fish	do	Gravel	do	70-80 Spruce	—	do	Pocket & Sh. Bl. 38	—	10	65.3	Rot & Split	—	18.2	Includes Pine, Spruce & Fir	do
5.10	—	—	Pocket Seasoned 3-4 mo.	185	—	0.510	1907	Knoxville Wis	C.B.&W.	do	do	90	Screw	Soft Pine	Light	1915	7.5	0	—	Good	—	2.0% Partly decayed	26.00
5.11	—	—	Pocket Seasoned 12 mo.	125	—	0.508	do	do	do	do	do	do	Cut	do	do	do	7.5	0	—	—	—	2.0% do	do
5.12	—	—	Pocket Seasoned 3-4 mo.	185	—	do	do	do	do	do	do	do	do	Hickory	do	do	7.5	0	—	—	—	11.2% do	do
5.13	—	—	Pocket Seasoned 12 mo.	13	—	0.508	do	do	do	do	do	do	do	do	do	1914	6.5	0	—	—	—	58.5% do	do

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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	ZINC CREOSOTE - ALLARDYCE																						
6.1	—	—	—	50	—	6x8 Sawn 20 Butts	1902	Drummond Bro	B.C.N.S.P.	Sand	Poor	60	Cut	None	Heavy	1911	9	180	—	—	—	All removed 1911	11.00
	ZINC CREOSOTE - CARD																						
7.1	—	—	—	513	—	6.5 Sawn 35 Butts	1899	Lines East	C.B.&Q.	Cinders Gravel Sand Clay	—	70-95 lb	—	Partly	—	1914	5	0	—	—	—		5.00
7.2	—	—	—	298	—	6	1910	〃	〃	Gravel	—	90	—	Nil	—	〃	4	0	—	—	—		〃
7.3	—	—	—	39	—	〃	1900	〃	〃	〃	—	95	—	Gravel Sand Clay	—	〃	3	0	—	—	—		〃
7.4	—	—	—	284	—	〃	1909	Lines West	〃	Cinders Gravel Sand Clay	—	85-90	—	Nil	—	〃	5	0	—	—	—		〃
7.5	—	—	—	211	—	〃	1910	〃	〃	Loose Stone	—	90	—	〃	—	〃	4	0	—	—	—		〃
7.6	—	—	—	8	—	8x8 Sawn 20 Butts	1911	Cardinal Mills	C.M.St.P.R	Gravel	—	95	—	A.S.Roof	—	1912	1	0	—	—	—		6.00
7.7	—	—	—	57	—	8x8 Sawn Many Butts	1902	Drummond Bro	B.C.N.S.P.	Sand	Poor	60	Cut	None	Heavy	〃	10	90	—	—	—	3 Years - 90% removed 1909	11.00
	ZINC AND CRUDE OIL																						
8.1	—	—	—	8	—	—	1904	Boden 211	C.B.&Q.	Gravel	—	75	—	—	Sawn & Sand Butts	1908-12	1	0	—	—	—		5.00
	ZINC TANNIN - WELLHOUSE																						
9.1	—	—	—	200	—	—	1891	Albany Jct.	N.Y.C.	—	—	—	—	—	—	1898	7	1	Decay	Good	—		3.00
9.2	—	—	—	100	—	0.58	1902	Drummond Bro	B.C.N.S.P.	Sand	Poor	60	Cut	None	Heavy	1912	10	100	—	—	—	Drilled to test 1912	11.00
9.3	—	Under None	Packed Seasoned Hem	125	—	0.428	1907	Janesville Wis	C.M.St.P.	Gravel	Good	90	Sawn	Salted	Light	1915	7.5	0	—	Good	—	14.4% Partly decayed	16.00
9.4	—	〃	Unpacked Seasoned Hem	50	—	0.440	〃	〃	〃	〃	〃	90	8"x8" Sawn	Salted Nailed	〃	〃	6	0	—	4	—	2.0% 〃	〃
9.5	—	〃	Packed Seasoned Hem	38	—	0.488	〃	〃	〃	〃	〃	90	〃	〃	〃	〃	4	0	—	4	—		〃
9.6	—	〃	〃	125	—	0.428	〃	〃	〃	〃	〃	90	Cut	Salted	〃	〃	4	0	—	4	—	15.2% Partly decayed	〃
9.7	—	〃	Unpacked Seasoned Hem	50	—	0.436	〃	〃	〃	〃	〃	90	〃	〃	〃	〃	4	0	—	4	—	6.0% 〃	〃
9.8	—	〃	Packed Seasoned Hem	120	—	0.408	〃	〃	〃	〃	〃	90	〃	Unknown	〃	〃	4	18	—	4	—	6.2% 〃	〃
9.9	—	〃	Unpacked Seasoned Hem	50	—	0.436	〃	〃	〃	〃	〃	90	〃	〃	〃	〃	4	0	—	4	—	10.0% 〃	〃
9.10	—	〃	Packed Unpacked Seasoned Hem	59	—	0.436	〃	〃	〃	〃	〃	90	〃	〃	〃	〃	4	0	—	4	—	14.1% 〃	〃
9.11	—	〃	〃	55	—	0.404	〃	〃	〃	〃	〃	90	〃	〃	〃	〃	4	18	—	4	—	14.5% 〃	〃
9.12	—	〃	〃	58	—	0.376	〃	〃	〃	〃	〃	90	〃	〃	〃	〃	4	17	—	4	—	20.7% 〃	〃
9.13	—	—	—	200	—	—	1912	Kaneville Ind	Milwaukee	〃	—	—	—	—	—	1915	13	180	—	—	Bad		22.40
9.14	—	—	Seasoned Hem	85	—	—	1910	Minneola	Rr I. R.	Loose Gravel	Good	80	Cut	—	Load after Ballasting	1918	18	180	—	—	Bad after 15	Track relaid	22.10 30.00
See METHLOCK Index Nos				M.S. M.6, M.7																			

TABLE 30 - VARIOUS SPECIES

	COPPER SULPHATE - THILMANY																						
10.1	—	—	—	—	—	—	1870	Chestnut Ohio	—	—	—	—	—	—	—	1895	5	—	—	—	—	Favorable to 1895	2.90
10.2	—	—	—	—	—	—	1877	—	Hitchcock	—	—	—	—	—	—	1882	5	〃	—	—	—	Unfavorable	〃
10.3	—	—	—	—	—	—	1878	—	〃	—	—	—	—	—	—	〃	4	〃	—	—	—	〃	〃
10.4	—	—	—	—	—	—	1879	—	H.P.R.R	—	—	—	—	—	—	〃	3	〃	—	—	—	〃	〃
10.5	—	—	—	—	—	—	〃	—	L.S.M.S.	—	—	—	—	—	—	〃	3	〃	—	—	—	〃	〃
	CREOSOTE																						
11.1	—	—	—	3581	—	—	1911.2	Hitchcock Nebraska	M.&C	—	—	—	—	—	—	1913	8	180	Rot	—	—	Not removed 1917 Ballasting 1919	16.00
11.2	—	—	—	76100	—	—	1896	Coal Dir	〃	—	—	—	—	—	—	1909	13	32	Bad rot	—	—		〃
11.3	—	—	—	84694	—	7	1907	Old Coal and Dockage	N.R.	—	—	—	—	—	—	1914	7	0	—	—	—	Bored Penetrated - no results	1.00
	MERCURIC CHLORIDE - (PRESSURE)																						
12.1	—	—	—	—	—	—	1906	Coal Mines.	—	—	—	—	—	—	—	—	—	—	—	—	—	Too costly	2.40
	MERCURIC CHLORIDE - KYAN																						
13.1	—	—	—	—	—	—	1902	—	B.&O.	—	—	—	—	—	—	—	—	—	—	—	—	Failure	〃
13.2	—	—	—	—	—	—	1905	—	Old Colony	—	—	—	—	—	—	—	—	—	—	—	—	Did not Pay	〃
13.3	—	—	—	—	—	—	1909	—	R.P.M.	—	—	—	—	—	—	—	—	—	—	—	—	do	〃
13.4	—	—	—	—	—	—	1851	—	R.P.R.	—	—	—	—	—	—	—	—	—	—	—	—	Apparently Most Removed - Strength 1.50	1.85
	OIL, CRUDE																						
14.1	—	—	—	100	—	—	1917	Boone Creek	Rock Creek	—	—	—	—	—	—	1918	4	0	—	—	—		2.00

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records which were secured were segregated into a much larger number of individual records, and this accounts for the fact that over 1,200 records appear in the accompanying tabulations.†

Tables 1-30, inclusive, present the data in detail. The records are arranged alphabetically by Species, Table 1 covering ash, Table 2 beech, etc. Each table of species is then further classified alphabetically by Preservatives, this classification being further subdivided alphabetically by Processes. Throughout these tables, column No. 1, entitled "Index Number," is used for convenience in referring to individual records in any table, and the numbering permits of the ready insertion of additional records which may subsequently become available. Column No. 24, entitled "Reference Number," refers to the accompanying sheets entitled "List of References and Authorities Quoted" which give the source and authority for all of the data included in the tabulation.

MR. M. K. TRUMBULL: Mr. Chairman, I think we will all agree that this is a masterly contribution, especially inasmuch as it is the first convention at which we have had service tests presented. I refer to this report and the others pertaining to paving blocks, timber, piling, etc. In my opinion the resolution passed one year ago to have committees prepare service tests has been amply justified. I would like to ask, in view of the recommendations and the necessity for the accumulation from year to year of records with service tests as to what plan or policy has been mapped out by the Executive Committee for the perpetuation of this work.

MR. L. B. MOSES: Mr. President, Mr. Card asks me to suggest that the most satisfactory way to continue those records, which are, of course, invaluable to us, would be to request the Forest Service to keep them for us. They would then be available for the information and guidance of the members of this Association. We would be assured, in the first place, that there would be no selfish interest attempting to serve its own ends, besides which the records would certainly carry much more weight with all who have occasion to use them. If that is feasible and the Forest Service people are willing to undertake the work I should certainly like to see it handled in that way.

THE PRESIDENT: Mr. Trumbull, my personal opinion is that this should be a standing committee and it should be continued from year to year. Of course, the present Executive Committee cannot outline the policies of the next Executive Committee, but that has been my thought in the matter.

†An exception to this general procedure occurred with a large number of records from C. B. & Q. Railroad. These included manw species and treatments, the ties being installed in a wide number of locations. To facilitate the preprartion of the tabulation, the records were merely classified according to their location in the "Lines East or West" of the Mississippi.

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MR. M. K. TRUMBULL: The question in my mind is as to whether it is desirable for the Association to act on this or to leave it in the hands of the incoming officers and Executive Committee.

THE PRESIDENT: Has anyone anything to say on that point? What is your pleasure? Do you want to leave it to the Executive Committee or does this Association want to instruct the Executive Committee to continue the Service Tests Committees as standing committees, not necessarily the same men?

MR. M. K. TRUMBULL: Mr. President, before we get down to the actual determination of our policy in this respect although appreciating Mr. Moses' suggestion, I would like to ask Mr. Winslow a question as to whether he finds that the railroads are liberal in their response to the requests for information as coming from the Forest Products Laboratory, or whether it places the Committee in a better position to secure that information if there are a few railroad men on the Committee.

MR. C. P. WINSLOW: First, in response to the question whether the railroads are liberal in responding to the requests for information of this sort, I will say yes. The assistance and co-operation they have given us in writing for information of that sort has been very gratifying. My personal feeling is that it would be an advantage to any committee of this sort to have railroad men as members. Of course, in correspondence from the Laboratory requesting most of this information that I have had to handle it has come as Laboratory correspondence rather than as individual correspondence, and I cannot say what the results might be on another basis. I only know that so far handling it as I have done in corresponding with these railroads we have met with very gratifying assistance from them and their co-operation in that is very highly appreciated and should have been acknowledged in the presentation of the report.

THE PRESIDENT: When the report of the Committee on Service Tests of Wood Block Paving was submitted they recommended that the Committee be continued and there was a motion to that effect. Now, I am ready to receive a motion to continue this Committee, and to make it a permanent standing committee if you so elect.

MR. M. K. TRUMBULL: Mr. President, I hardly think we are quite ready for that motion to be put. We should consider the fact that the American Railway Engineering Association has done a considerable amount of work in this line. We should have an expression from some of the railroad men present. It is unfortunate that Mr. Stimson and some of the others have already left. We should secure expressions from as many as possible as to the desirability of merging the work of this Committee with that of the American Railway En-

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gineering Association, or to adopt some policy, as between the two associations, which will give the best results to all that are interested in the requirements.

THE PRESIDENT: Gentlemen, what is your pleasure?

MR. E. T. HOWSON: Mr. President, I would like to support the ideas just advanced.

There is so much to be done by all the technical associations that any overlapping means that some other work will not be done. This Association can gather certain statistics on service ties better than the other association. The other association can gather statistics from certain other sources perhaps better than this Association, because of its more direct affiliation with the railroads. For that reason it seems to me that a joint committee of the two associations could combine the information secured by each into a more comprehensive report than will be available otherwise. Each association would have the benefit of it, there would be no duplication and corresponding disagreement in minor details and we would get all the benefit of the individual reports.

I would, therefore, suggest that the Executive Committee consider the advisability of suggesting to the American Railway Engineering Association's Board of Directors the appointment of a joint committee to study the service tests of ties as this matter applies to both associations.

THE PRESIDENT: Mr. Howson, if you will allow me to suggest, we certainly ought to accept the report of the Committee. Can you not make a motion to that effect? Then recommend that the incoming Executive Committee confer with the American Railway Engineering Association and so forth?

MR. GEO. E. REX: Mr. President, I would like to move that the report of the Committee be accepted, and if it is in order, I would also like to move that the incoming Executive Committee be instructed to continue Mr. Winslow as Chairman of this Committee as a standing committee.

THE PRESIDENT: You are in order.

MR. GEO. E. REX: I think this has been a magnificent work, one that needs the study of those who have the time and technical knowledge to put into it. I think that Mr. Winslow deserves great credit and I would like to see him continue as Chairman.

MR. M. K. TRUMBULL: I second that motion, Mr. President.

THE PRESIDENT: The motion is that we accept the report and continue Mr. Winslow as Chairman of that Committee and that the

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Executive Committee confer with a like committee of the American Railway Engineerng Association, take it up with the Board of Directors, with the view of having a joint committee appointed. Are you ready for the question? Those in favor say Aye, those opposed No. The Ayes have it.

The next order of business is the report of Committee No. 7 on Service Tests of Bridge and Structural Timber. When I came into the hall there was a gentleman who said he was not a member of this Association but he wanted to know when this report was going to be made. After the report has been made, if he has anything to say—I do not recognize him now, but I presume he is here—we will be glad to recognize him and let him talk on the subject. The report will be read by the Secretary.

SECRETARY ANGIER: This report is submitted by a committee consisting of Mr. H. M. Rollins, (Chairman) Mr. E. Stimson and Mr. H. E. Horrocks. No member of this Committee is present, and, therefore, I will read a part of the report.

REPORT OF COMMITTEE ON SERVICE TESTS OF BRIDGE AND STRUCTURAL TIMBER.

To the Members of the American Wood-Preservers' Association:

In 1880 the American Society of Civil Engineers appointed a Committee on Preservation of Timber. Five years later (1885) this committee made its report, and no doubt this report has been recognized as the best collection of data concerning timber treatment that has ever been assembled in this country; and its recommendations have been heeded more often than those of any kindred report or treatise.

Almost every report on the durability of treated timber that has been made since this report of 1885 has referred to some of the specimens exhibited in this report of Octave Chanute's.

The committee above referred to, headed by one of the most eminent engineers of this country, and the one man who did most for the development of timber treatment in this country, required a period of five years to collect and arrange the subject-matter of its report.

We, your Committee No. 7, feel that the little we have accomplished in the few months time available for this work, is little indeed, as compared with the report above referred to.

In the Proceedings of 1915 you have a report similar to the one you request this Committee to make, which has covered the ground in a much more thorough way, than it would be possible for us to do in the time and means at our command.

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The size or length of this report does not begin to represent the extent of our labors in trying to collect the desired data; for you must know, you who have done this character of work, that the men from whom such data must be secured are very busy men, and that in addition they are men who hesitate to make statements, unless they have conclusive evidence to support such statements.

A great deal of the material that has come to us is a duplication of reports submitted by Messrs. Weiss and Teesdale, and published in the 1915 Proceedings. This we omitted.

With this before you, we direct your attention to the attached report and papers thereto attached.

We would recommend that the work assigned to this Committee be assigned to our Forest Service members, as a permanent committee, as they are always on the alert for just such information as we have tried to collect. They could make annual reports of new data discovered during the year, and same could be added to the exhaustive report given by them in 1915; and this report with its additions from year to year could become a permanent feature of our Proceedings.

Should the Association be so unfortunate as not to secure this cooperation from our Forest Service members, then we recommend that there be appointed a permanent committee on this work, which will make progress reports from year to year.

H. M. ROLLINS, *Chairman.*
E. STIMSON,
H. E. HORROCKS.

NORFOLK AND WESTERN RAILWAY COMPANY'S SPECIFICATIONS FOR CREOSOTED TIMBER AND PILING.

(SPECIFICATION M. W. 12, MAY, 1912)

Timber and Piling

All timber or piling used for creosoting treatments shall be free from wind shakes, large, loose or decayed knots, redheart or anything impairing its strength; and it is to be cut from sound, live trees. The timber or piling shall be Virginia or North Carolina pine, unless otherwise specified in the contract.

Creosote Oil

The oil used shall be the best obtainable grade coal-tar creosote; that is, it shall be a pure product obtained from coal-gas-tar or coke oven tar, and shall be free from any tar, oil or residue obtained from petroleum or any other source, including coal-gas-tar or coke oven tar.

It shall be completely liquid at 38° C. (100.4° F.), and shall be free from suspended matter; the specific gravity of the oil at 38° C. shall be

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at least 1.03 and not above 1.06. When 100 grams of the oil are distilled by the common method, that is, using an 8-oz. retort, asbestos covered with standardized thermometer, bulb ½ in. above the surface of the oil, the creosote, calculated on the basis of the dry oil, shall give no distillate below 200° C. (392° F.) and not more than 5% distillate below 210° C. (410° F.), a minimum of 35% between 210° C. (410° F.,) and 235° C. (455° F.), and the residue above 355° C., if it exceeds 5% in quantity, shall be soft. The oil shall not contain more than 3% water.

Treatment

The several steps are: The seasoning, the extraction of the sap and water (vacuum process) and the injection of the oil. The seasoning is to be accomplished by subjecting the charge of timber directly to the action of live steam at a pressure of 70 to 80 lbs. per square inch for a period of from 5 to 7 hours, the temperature not exceeding 275° F., unless the timber be thoroughly water soaked, in which event it may reach 350° for the first half of the seasoning period. At the expiration of the seasoning process, the cylinder shall be entirely emptied of all sap, water, etc., by drawing off at the bottom. This having been accomplished, a vacuum of not less than 20 in. shall be set up and maintained within the cylinder for a period of from 5 to 8 hours, or until the discharge from the pump has no odor or taste of turpentine, the temperature within the cylinder being maintained at not less than 120° F. during this period. The cylinder having been emptied of everything except the charge of timber, the oil is to be admitted and such a pressure set up as shall cause each piece of timber or piling constituting the charge to absorb not less than 12 lbs. of oil for each cubic foot of its contents, at a minimum penetration of 1½ in. from all surfaces, the depth of the penetration being ascertained by boring each piece with an augur, making a hole not more than ¾ in. in diameter. Such pieces as are found not to have the required penetration may be returned to the cylinder with a subsequent charge for further treatment. The test holes shall be creosoted and charged with creosote oil.

The engineer, or any other duly authorized representative of the Norfolk & Western Railway Co., shall have not less than 48 hours notice of the intention to begin the treatment of a charge of timber, and it is expressly understood that he shall have all necessary and reasonable facilities for ascertaining that any and all of the requirements of this specification are complied with. Such facilities are: Access to the works at all times during the execution of this contract; opportunity to make such measurements of timber, cylinder, oil tanks, etc., as are necessary for determining the amount of oil used for the charge, and for taking such samples of oil as he may find necessary for testing purposes. Also such necessary quarters and apparatus free of cost, so that said railroad company's inspector may make all tests of the oil previous to its use, to determine if it is in accordance with these specifications.

All creosoted timber to be delivered as directed.

WAR DEPARTMENT SPECIFICATION FOR PILING AND LUMBER.

(U. S. ENGINEER'S OFFICE, NEW ORLEANS, LA., OCT. 16, 1915.)

(a) Piling and lumber to be thoroughly creosoted; lumber with 14 lbs. creosote, and piling with 20 lbs. creosote to the cubic foot.

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RECORD OF TREATED BRIDGE AND STRUCTURAL TIMBER.

Location	Kind Of Timber	Species	Process	Preservative	Pounds Per. Cu. Ft.	Date Placed	REMARKS:
Southern Ry.	Ballast Deck Bridges	Pine	Full Cell	Creosote	16	1905	Still in use.
" "	Tank Frames & Highway Bridges	"	" "	"	16	Since 1909	Still in use.
Seaboard Air Line	Piling	Loblolly	" "	"	24	1903	Still good except few removed, account teredo entering where loose knots were developed; untreated piles are destroyed, here, Manatee River 1 to 2 years.
" " "	Trestle	Pine	" "	"	16	1909	Still in use. All material treated according to A. R. E. A. specifications.
P. & R. R. R.	Not in use long enough to establish any record of value						
Central of Ga.	Not in use long enough to establish any record of value						
Lehigh Valley	Newark Bay Trestle	Bull Pine	Full Cell	Creosote	Piling, 12 Caps 10	1890	Still in good condition, 1938 Piling put into structure. Still in good condition, 1938 Caps put into structure.
" " Jersey City	Pier No. 8	Yellow Pine	" "	"	Piling, 10 Timbers, 8	1890	Still in good condition
Lehigh Valley Perth Amboy	So. Frt. Wharf,		" "	"	Piling, 10	1888	Still in good condition. This material in the Coal Dumper Pier.
Lehigh Valley	Highway Bridge			"		About 1890	Still in good condition. This is bridge No. 43 E. of Mechanic, N. J.
" " Perth Amboy	Coal Dock "A"			"	Piling, 12 Timbers, 10	1886	Still in good condition.
Norfolk & Western	Piling	Va. Pine	Full Cell	"	12		Decay at top account teredo entering where creosote protection was defective

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RECORD OF TREATED BRIDGE AND STRUCTURAL TIMBER.—Continued.

Norfolk & Western	Sheet Piling	Pine	Full Cell	Creosote	12		Cause for removal, decay. Average life for piling. { 15 to 24 years / 8 to 12 years (See specifications attached.)
" " "	Framing for Docks & Fenders	N. C. Pine	" "	"	12		Draw bridge fenders removed account mechanical wear.
" " "	Floor Joists	" " "	" "	"	8		
D. L. & W.	Guard Rails Bergen Tunnel	Yellow Pine	" "	"	12	1908	Still in service.
" " " "	Bridges	" "	" "	"	12	1908	Still in service.
War Department U. S. Engineer Office, New Orleans, La.	Piling & Timbers	L. L. Yellow Pine	" "	"	Piling, 20 Timbers, 14	About 1907	Piling and timbers in coal dock in good condition. Piling and timbers in other structures, varying in age 1 to 6 years. All in good condition. Derrick timbers creosoted as shown lasted 7 years, rotted at base and at splice, due to accumulated moisture and wearing away of edges at base, exposing interior of timber. (See specifications attached.)
Sunset-Central Lines	Signal Poles	Yellow Pine	" "	"	10 & 20	1904-1910	3 or 4 poles out of 17,927 put in use between the years 1904 and 1910 broke off in high winds at the ground line, and showed decay at that point.
United Fruit Co.	Not in use long enough to establish any record of value						Use only creosote as a preservative; conditions very severe.
I. C. R. R.	Piling & Timbers		Full Cell	Creosote	Piling, 18 Timber, 16	1902-1915	About 1% of the old timbers have been removed account decay; these failures are due largely to not protecting the cut-offs, and to holes being too large. (For drift bolts and other bolts, see letter and specification of Ill. Central R. R., attached.)
M. K. & T. Ry.	Piling Not in use long enough to establish any record of value				16		Only creosote piling; other timbers untreated; expect life 15 to 18 years.
C. M. & St. P.	Bridge Timbers			Creosote	12 to 16	1904-1915	All material in good condition in 1915.
Idaho & Wash. No.	Bridge Timbers	Fir	Boil & Steam	"	12	1909-1914	All material in good condition in 1915.

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Lumber to be square edge and sound.

Piling to be of yellow pine, straight, not less than 12 ins. nor more than 18 ins. at the butt; not less than 8 ins. diameter at small end; to be stripped of bark, cut square at both ends, and of a uniform taper from end to end.

Derrick timbers to be of longleaf yellow pine, of the very best grade, sawed to size, seasoned if possible.

(b) All piling will be longleaf yellow pine, straight and sound, clear of bark, not less than 12 ins. nor more than 18 ins. diameter at the butt, not less than 8 ins. diameter at the small end, both ends cut square. Lumber will be square edge and sound longleaf yellow pine. All piling and lumber must be creosoted with the best obtainable dead oil of coal tar. Piling will receive not less than 20 lbs. of oil, and lumber not less than 14 lbs. of oil per cubic foot.

The creosote oil must be as follows:

Specific gravity, not less than 1.03 at a temperature of 60° F. It must liquify at 95-100° F., must not boil below 400° F. and must contain not less than 37-40% naphthalene. If the oil shows over 2½% water, compensation must be made for the water. No oil containing over 8% of water will be used.

The steam-seasoning must be made by the direct application of live steam admitted into the treating cylinders. Superheated steam must be passed through heating coils so as to maintain the interior of the cylinders at a temperature of from 250-285-300° F. At the end of the steaming period the timber must be further seasoned by vacuum created in the cylinders, the temperature being at all times maintained above the boiling point corresponding to the vacuum. During this process the accumulated moisture must be frequently removed from the cylinder.

When the foregoing has been done, and it has been ascertained that no sap or moisture remains in the cylinder, the creosote oil will be admitted at a temperature of not less than 150° F., which must be raised to 200° F., and pressed into the wood under a pressure of 125 lbs. per square inch. The force pump producing this pressure shall be kept in operation until the wood has absorbed the desired quantity of oil. Pressure will then be lowered and the wood promptly removed from the cylinder to avoid loss of oil from dripping.

Local conditions affecting period of usefulness of the creosoted material at Southwest Pass are the fact that piles are exposed to salt water for only about four months in every year. Under these conditions it may be safely stated that creosoted piles here will have a life of 20 years, if not more. The painting of timbers with creosote has not been entirely satisfactory, as the creosote is soon dried out by the sun, and especially where timbers are exposed to wear, as soon as the timber is worn below the coat of creosote, it rots as does the untreated timber.

SPECIFICATIONS OF THE ILLINOIS CENTRAL RAILROAD COMPANY.

The oil shall be the best obtainable grade of coal-tar creosote; that is, it shall be a pure product of coal-tar distillation and shall be free from admixture of oils, other tars or substances foreign to pure coal-tar; it shall be completely liquid at 38° C., and shall be free from suspended matter; the specific gravity of the oil at 38° C., shall be at least

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1.03. When distilled according to the common method, that is, using an 8 oz. retort, asbestos covered, with standard thermometer, bulb ½ in. above the surface of the oil, the creosote, calculated on the basis of the dry oil, shall give no distillate below 200° C., not more than 5% below 210° C., not more than 25% below 235° C., and the residue above 355° C., if it exceeds 5% in quantity, shall be soft. The oil shall not contain more than 3% water.

Maximum steam pressure shall not exceed 25 lbs. per square inch.

During the process of steaming, the cylinder must be frequently drained by a valve located at the lowest possible point. The steaming must continue from 5 to 12 hours, according to the degrees of seasoning, the size of the lumber and the quantity of oil to be injected into it. At the end of the steaming period a vacuum shall be created in the cylinder, the temperature being at all times maintained above the boiling point. The vacuum must continue until the gauge shows a reading of from 22 to 26 in., and must be kept at that reading for from 2 to 5 hours. After it has been ascertained that no sap or moisture remains in the cylinder, the oil shall be admitted at a temperature of not less than 150° F., which temperature shall be raised to not less than 170° F., under pressure of not less than 100 lbs. to the square inch. The force pump producing this pressure shall be kept in operation until the established system of measurement shows the wood to have absorbed the desired quantity of oil. The pressure shall then be released, and the timber completely treated and ready for removal.

The amount of oil injected to be gauged by the difference between the reading of the measuring tank gauge before the oil is admitted into the cylinder and after it is pumped back into the measuring tank at completion of treatment.

The treatment of timber shall be done under the direction of an inspector or inspectors employed by the Railroad Company, and in all respects to his or their satisfaction.

The Creosote Works shall, whenever requested to do so, furnish the Railroad Company, or its inspectors, samples of the oil being used. Every detail of the work herein agreed to be done by the Creosote Works shall be fully explained to the inspectors, or other officers or agents of the Railroad Company, and every facility shall be given them for the inspection of the work. A statement showing the cubical contents of every load of timber shall be furnished to the said inspectors for their record, and they shall have access at all reasonable times to all records of the Creosote Works, pertaining to the treatment of timber for the Railroad Company.

The quantity of oil to be injected into timber to be 16 lbs. per cubic foot, and for piling to be 18 lbs. per cubic foot.

Communication dated Oct. 6, 1915, from E. H. Bowser, Superintendent Timber Department Illinois Central Railroad Co., Memphis, Tenn.

We have not been using treated timber long enough to give any very definite information. The oldest timber we have was treated in 1902, and we have had comparatively few failures. In a few structures we have had quite a number of failures, but the per cent. for all the old material is not more than 1%, and these failures are largely due to improperly preparing the cut-offs of the piles, and improperly boring the holes for bolts, i.e., the bolt holes were not made so there would be a "driving fit."

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Practically all of our failures have been south of the Ohio River. I will answer your questions in order as asked.

1—*How much of this class of material have you in use?*

Ans.—About 96,000,000 ft. B. M.; half timber and half piling, piling running 9 ft. B. M. per lineal foot.

2.—*What is the longest period of service you have ever gotten from creosoted material?*

Ans.—Thirteen years. This being the oldest material we have on our lines.

3.—*Please give specifications under which material was furnished and treated, and local conditions that might affect its period of usefulness.*

Ans.—Copy of specifications attached. (Above.)

4.—*What is the shortest period of service you have ever gotten out of creosoted material? To what do you attribute its short life?*

Ans.—Five years. Some of this material was poorly treated, and this was the sole cause of failure. A small amount of material we have had fail in 7 years, due in small part to poor treatment, and a large part to not properly treating by hand the tops of piles after they were cut off, and by not boring holes smaller than the bolts so that there would be a "driving fit."

5.—*Please give specifications under which same was furnished?*

Ans.—Same as No. 3 above.

6.—*What is the average life of creosoted material of this character in your work?*

Ans.—Have not been using it long enough to give average life. We figure that 90% of it will last from 30 to 50 years.

7.—*Have you used any other preservative than creosote for this class of material? If so, what did you use and what service did you get?*

Ans.—We have used zinc chloride (½ lb. per cu. ft.) for treating all longleaf timber that has had too much sap on it to be used without treatment, and this treatment was merely to make the sap last as long as the heart, and the results have been good. We use this treated material with all heart untreated longleaf pine. We find that treatment with zinc chloride will very much prolong the life of this timber, the heartwood as well as the sap-wood. We have just begun treating with zinc chloride, all bridge material for open-deck trestles.

8.—*Have you made any definite service tests on this class of material? If you have, what results do you anticipate?*

Ans.—We have no specially prepared service tests on this class of material. We have the dates on which the creosoted structures were built, and we consider this a much better method of getting a record, than from any specially made tests, for which, nine times out of ten, the material is specially treated and handled and does not conform to the ordinary practice. We figure the sap-wood will last as long as the heart-wood, and the sap-wood not decaying, will be a protection against fire from hot coals dropped from engines, and that all of the material will last longer than all heart yellow pine, untreated, probably 30% longer.

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9.—*Please indicate for what reason most removals were made.*

Ans.—Removals were made partly from bad treatment, partly from improperly protecting parts framed after treatment, and partly from decay around the bolt holes, due to the holes being too large to make a tight fit for the bolt. This applies to creosoted material only as we have not been using zinc chloride long enough to show results.

I think the last paragraph in answer to No. 8 is meant to apply to material treated with zinc chloride.

THE PRESIDENT: We are prepared for a discussion of this report. Has anyone anything to say?

MR. E. B. FULKS: Along this line you passed discussion on the other committee. I move the adoption of this report with the exception that they have got two recommendations for the continuation of the work, neither of which I exactly think the better. I approve of either one, but I think there is a still better solution. What this all comes back to is this: All of this information, or as you said in your opening address the other day, practically 95% comes from railroads.

Now, if there are 17 different committees writing railroads every year asking for information about how many ties were taken out, another committee asking how many bridge timbers were taken out, this, that and the other, besides 48 different inquiries from the Interstate Commerce Commission, the engineer gets good and sore and says, "Away with the whole business. I have got no time for that." He does not answer anybody.

I should say the idea would be to consolidate these things as much as possible, and I can see no reason why the work of this Committee could not be handled by Mr. Winslow's Committee along with the other matter, and the whole thing in conjunction with a similar committee of the American Railway Engineering Association, all of whom would ask certain questions once for all of the railway engineer, and he would answer them and be done with it, if he had some assurance that somebody would not ask him for it. I suggest the arrangement for continuance there be changed and put into the hands of Mr. Winslow's Committee.

MR. F. J. ANGIER: I second the motion.

MR. M. K. TRUMBULL: Before that motion is put, I should like to ask whether there is any committee of the American Railway Engineering Association that accumulates tests on timbers and piling such as it has for ties.

THE PRESIDENT: Mr. Rex, can you answer that question?

MR. GEO. E. REX: I cannot.

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THE PRESIDENT: I do not know of any such committee. I know there is a committee that collects information on service tests for ties. You know that, but I do not know of any such committee on bridge timbers.

MR. E. B. FULKS: I do not know that there is any such committee and in making my talk I did not want to infer that, but if they have not such a committee they would be very glad indeed to get this information, not that they would not be privileged to ask for any information they want. Our committee would put up such questions as we wanted and they would add such questions as they wanted and all the questions would go to the man at once. He would just as soon answer many as a few, but he does not want to be constantly looking up information.

MR. F. D. MATTOS: I believe, Mr. President, that the American Railway Bridge and Building Association has a committee such as Mr. Trumbull mentioned, because I believe three years ago I was a member of that committee.

THE PRESIDENT: That brings up the point this gentleman over here mentioned. There are three different committees asking the engineer for reports.

MR. M. K. TRUMBULL: Mr. President, I understand that the work of the American Railway Bridge and Building Association does not overlap much of the work of the American Railway Engineering Association. It might be that it would be necessary for us to collaborate with the committee of the Bridge and Building Association rather than that of the American Railway Engineering Association in this particular report. If agreeable to Mr. Fulks, I would suggest that we provide an amendment to his motion so that the Executive Committee can handle this matter to the best of its judgment so as to get the results we are after.

THE PRESIDENT: To save time, include that in your motion.

MR. E. B. FULKS: I am perfectly agreeable to that. My point is not to co-operate with the outside associations but to consolidate these other committees of our own. We may not be able to co-operate with the other associations, they may not want us, but we certainly can control the consolidation of our two committees. That is what I am driving at.

THE PRESIDENT: Any further discussion? If not, all those in favor of the question will say Aye, opposed No. The Ayes have it.

I understand that Committee No. 9 will make no report.

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BUSINESS SESSION.

THE PRESIDENT: Now, we pass to the business session. If you people will be patient and prompt, we can handle this report of the Committee on Constitution and By-Laws very quickly and then we will be through before one o'clock.

MR. CARL G. CRAWFORD: I make a motion that the first order of business in the business section be that of selecting the meeting place for next year.

MR. O. C. STEINMAYER: I second the motion.

THE PRESIDENT: It is moved and seconded that in this business session that we first take up the selection of the next meeting place. Those in favor of that motion will say Aye, opposed No. The Ayes have it. One of the gentlemen has called my attention to the fact that the report on zinc chloride has been passed over. Mr. Townsley was unable to be here and he did not prepare a written paper. That is the reason why that is omitted. Mr. Secretary, what communications have you on the meeting place?

THE SECRETARY: First we have a message from the General Secretary of the Chamber of Commerce, Philadelphia, received yesterday:

> On behalf of the Philadelphia Chamber of Commerce I would request that the next meeting of your Association be held in the City of Philadelphia. We would be glad to extend you the courtesy of our convention hall and offer such hospitality as Philadelphia is noted for should you accept this invitation.

In addition to that, we received a letter from the Secretary of Municipal Affairs and Conventions, Philadelphia.

From New York we have a letter from Marcus M. Marks, President of the Borough of Manhattan; Secretary of the Merchants' Association of New York; the Librarian of the Municipal Reference Library; Mr. Draper, who is one of our members, with the American Creosoting Co.; Mr. Griffin of the Western Electric Co.; Mr. W. C. Meredith, of the Southern Wood Preserving Co.; Mr. R. Ernest Beady, all inviting us to go to New York.

From Boston we have a letter from Mr. Eastwick, one of our members; from the Mayor of Boston, and from the President of the Boston Convention Bureau, inviting us very cordially to hold our convention in Boston.

From Buffalo, a letter from the Mayor, from the President of the Buffalo Chamber of Commerce, from the Commissioner of the Convention Bureau, inviting us to hold our convention in the City of Buffalo.

From Baltimore, a letter from the Governor of Maryland, from

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the Mayor of Baltimore, from the Director of the Municipal Department, City of Baltimore, and from the Merchants' and Manufacturers' Association, inviting us to hold our next convention in Baltimore.

St. Louis invites us through Dr. von Schrenk.

Charleston, S. C., from the Secretary of the Tourists and Convention Bureau of the Chamber of Commerce.

Columbus, Ohio, from the manager of the Columbus Conventions and Publicity Association.

THE PRESIDENT: Gentlemen, I am ready for nominations for the next meetign place, or to receive a motion.

MR. J. C. WILLIAMS: Mr. President.

THE PRESIDENT: Mr. Philadelphia.

MR. J. C. WILLIAMS: I am half way, in between Philadelphia and New York. I move we take a complimentary ballot on the names as read by the Secretary and take a formal ballot on the three cities having the highest number of votes in the complimentary ballot.

THE PRESIDENT: Do you mean to distribute ballots?

MR. J. C. WILLIAMS: No, just a rising vote.

THE PRESIDENT: Before putting that motion I want to recognize Mr. Armstrong from Chicago.

MR. A. R. JOYCE: Mr. President and gentlemen: I want to introduce to you Mr. Armstrong of the Chicago Association of Commerce, Bureau of Conventions, who has done so much to make our convention here pleasant and enjoyable—Mr. Armstrong (applause).

MR. F. W. ARMSTRONG: Mr. President and gentlemen: It is my pleasure to extend to the American Wood-Preservers' Association an invitation, on behalf of the City of Chicago, through the Chicago Association of Commerce, to hold their next convention in the City of Chicago. I would like to read an editorial from the "New York Times" about Chicago getting the two political conventions. (The "New York Times" is noted as being a very conservative paper.)

> San Francisco has just launched a campaign to win the next national convention of the Republicans. The National Committee is to meet in December to decide that question. Other cities are also in the race, or will be, and the National Committee may be misguided enough to select some other than Chicago.
>
> Bidding and wire-pulling decide this matter far too often. But those who are not attending their first convention, those who go regularly as delegates, or whose business takes them there, will pray mightily that the committee may be gifted with a sense of duty.
>
> There ought to be a law providing that all national conventions of the two principal parties be held in Chicago.
>
> A convention can never be comfortable, but it is nearly comfortable in Chicago. The surroundings of a convention can never be

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business-like, but they are as business-like as possible in Chicago. There is as little as possible there to fret and worry delegates into making a hasty decision on some momentous question so that they can get out of town on the next train.

A convention can never be evenly poised and calm, with an unfretted mind, intent only on the welfare of the party, and Chicago is the only place where the worries are so few that that condition can be approximated.

The reason is that Chicago is no amateur. Handling a convention is part of her business; she knows it from stem to stern, having set about acquiring the details in her youth and has studied and practiced it ever since.

Chicago's advantage over such a place as Kansas City is the advantage that a white-whiskered and prosperous merchant has over a youthful shoestring peddler. Denver is a fine town, and with forty or fifty years' practice might be able to handle a convention as well as Chicago, and better, anyhow, than she did the Democratic convention of 1908. Baltimore—but why rake up terrible memories?

Gentlemen, the American Wood-Preservers' Association: You wonder how we know this. Let me tell you an incident. We arranged a trip for the ladies to one of the large mercantile houses and hoped that the gentlemen could change their program so they too could go, but at the last minute we were told that it would be impossible as you were too busy. An organization like yours, composed of busy men who come to a convention strictly for business, should go to that city which enables the greatest number of your members to be present and derive the full benefit accruing from attendance at your sessions. You are all familiar with Chicago's advantages as a convention city: its splendid hotel accommodations and unequalled transportation facilities, and you know, therefore, that Chicago offers the inducement which you gentlemen want—a city that will enable most of your members to attend to your convention under most desirable conditions, viz: maximum comfort and minimum expenditure of time. I thank you (applause).

THE PRESIDENT: Now, we will recognize a man from New York, if he is here.

MR. S. R. CHURCH: I want to say, Mr. President, that I am in favor of Chicago as the meeting place for this Association as a general proposition and most of the time. Personally I hope the Association does not meet in New York, because I know what that will mean to me, but I think it is only fair on behalf of New York to have at least one advantage set forth as long as you did not have time to read that letter. I believe the members will agree with me that there is no large city in the country that needs education on the subject of wood preservation as badly as it is needed in New York. There is no place where the field has perhaps been less cultivated.

Now, I think an extraordinary amount of attention has been given to the matter by the Merchants' Association. New York does not ordinarily get out and hustle for its conventions, and they are very anxious to have the Wood-Preservers come there, and the convention would get considerable publicity in the papers, which would be very

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desirable, I think, from the standpoint of enhancing the public knowledge of wood preservation in that section of the country and in New York City in particular. That is about the only argument I have to bring up except that there are a lot of treating plants in the East, and this argument applies to any locality, who will be given an opportunity to attend a convention of this Association and who ordinarily do not attend the Association because of lack of time or inclination to come to Chicago. That worked out in the South. There were a lot of men there whom you do not see here at these Chicago meetings. You were giving them a certain benefit. Possibly the Association was losing something, on the other hand, but it is at least a question worthy of discussion whether an occasional meeting away from Chicago is not worth while.

THE PRESIDENT: Mr. Loud suggested under this motion that we ought to let each city through its representative present its case. We have let Chicago come forward, or someone represent it, to present Chicago. Now, we should take them up and then there will be opportunity for general discussion. Baltimore first.

THE SECRETARY: No.

THE PRESIDENT: The memory you do not want (laughter). Boston (no response), Buffalo (no response), Columbus, Ohio (no response). Chicago is passed. Charleston, S. C. (no response). New York, Mr. Church has spoken. Philadelphia.

MR. JOHN FOLEY: I will save the time of the Association by merely asking that in the remarks made by Mr. Church Philadelphia be substituted for New York, omitting the confession of ignorance that may exist regarding wood preservation. We know something about it in Philadelphia and Pennsylvania.

THE PRESIDENT: St. Louis (no response). Now. Mr. Rex. you started to get on your feet. Have you anything to say?

MR. GEORGE E. REX: No.

THE PRESIDENT: Mr. Crawford, what have you got to say on this motion?

MR. CARL G. CRAWFORD: I believe I have nothing to say on this motion more than to ask a question. The way the motion was put it took into account only the names of the cities from which invitations were read by the Secretary.

THE PRESIDENT: Yes.

MR. CARL G. CRAWFORD: Would that motion include these other cities from which invitations have been received, or do you restrict the motion to cover only the cities from which invitations had been read previous to the time the motion was offered?

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THE PRESIDENT: I will interpret the motion to read the cities that I have read to you, which include all the cities that we have received invitations from. Unless the house overrules me, that ruling will stand.

MR. A. R. JOYCE: Mr. President, I would like to emphasize the point that what Mr. Armstrong read was from one of the leading New York papers, an editorial from the "New York Times," about Chicago as a convention city. It is what New York says about Chicago.

THE PRESIDENT: If there is no further discussion, all those in favor of the motion will say Aye, opposed No. The Ayes have it.

The first vote is to be a complimentary vote. Is there any further discussion? If not, Mr. Williams, will you explain just how we ought to do this?

MR. J. C. WILLIAMS: Let the Secretary read the name of the first city, Boston, I think, is at the head of the list. Those in favor of Boston will hold up their hands. The Secretary can count them, and then he will call for the next city, and so on down the list. Then we know how many are in favor of each city. Then we eliminate all the cities except the three leading ones. Then we take a final vote on the three leading cities.

MR. F. D. MATTOS: Mr. President:

THE PRESIDENT: Do not put San Francisco in (laughter).

MR. F. D. MATTOS: Why not pass the ballot around and let everybody vote?

THE PRESIDENT: That would take too long. The Secretary can read the names.

The following votes were cast for the respective cities as the Secretary announced them:

Baltimore	1
Boston	1
Buffalo	0
Columbus	1
Chicago	34
Charleston, S. C.	0
New York	25
Philadelphia	4
St. Louis	2

THE SECRETARY: The three highest are Chicago, New York and Philadelphia.

THE PRESIDENT: I think we should eliminate everything except New York and Chicago. Would that be satisfactory to you, Mr. Foley?

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MR. JOHN FOLEY: Yes.

THE PRESIDENT: Now prepare your ballots. We will vote by ballot. I would like to have Mr. Moses and Mr. Graham count the ballots.

MR. W. H. FULWEILER: Do I understand that in the past the Association members have been permitted to vote for the next place of meeting?

THE PRESIDENT: This is the way I will rule on it. If there is no objection from the house, I will rule that the Associate, Corporate and Honorary members can vote on it (applause). Now, I do that because I believe that is fair to the Associate members. They are not voting on anything that governs this Association.

THE PRESIDENT: The Secretary will announce the results of the ballot for the meeting place.

THE SECRETARY: Chicago, 34; New York, 54 (applause).

THE PRESIDENT: Someone move that New York be made the unanimous choice of the convention.

MR. F. D. MATTOS: I move that New York be unanimously selected for the meeting place.

MR. AUGUST MEYER: I second the motion.

THE PRESIDENT: Is there any discussion? All those in favor of the motion say Aye, opposed No. The Ayes have it.

REVISION OF CONSTITUTION.

THE PRESIDENT: The President requested Mr. Foley, with the approval of the Executive Committee, to prepare a revision of the Constitution. This is one of the most important pieces of work at this convention. How are we going to handle it? I think we ought to read it section by section and adopt it as we go along, and then at the end approve it entirely. We can avoid the reading of it, and take up Section 1, and ask if there is any objection to it. I do not want to be arbitrary, but I want to get some lunch today, so let us hurry along. Mr. Foley begin.

(These amendments were offered by five Corporate members, namely, John Foley, H. S. Loud, Frank Schilling, Charles C. Schnatterbeck and C. M. Taylor).

MR. JOHN FOLEY: As I hope was evident from this proposed Constitution, a very decided effort was made to stick to the old one as closely as possible. I move that Article I, Section 1, of the proposed Constitution be adopted.

MR. J. C. WILLIAMS: I second the motion.

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THE PRESIDENT: Those in favor say Aye, opposed No. The Ayes have it.

MR. JOHN FOLEY: I move that Article I, Section 2, be adopted.

MR. J. C. WILLIAMS: I second the motion.

THE PRESIDENT: You have heard the motion. Those in favor say Aye, opposed No. The Ayes have it.

MR. JOHN FOLEY: I move that Article I, Section 3, be adopted.

MR. C. W. LANE: I second the motion.

THE PRESIDENT: It is moved and seconded that Article I, Section 3, be adopted. Have you anything to say on the question? Those in favor say Aye, opposed No. The Ayes have it.

MR. JOHN FOLEY: Section 1 of Article II introduces an innovation, an attempt to change what was Junior membership to one of a somewhat different type.

When Junior Members were proposed last year for the old Constitution, there seemed to prevail the idea that by making dues low and allowing anybody who wished to join the Association to come in as a Junior Member, there would be a large increase in the membership roll. There have been admitted to membership only two Junior Members. The consideration that I understand weighed was that students in engineering courses would be tempted to become members. That, of course, has not proved to be the case, and I cannot see why it is likely to in the future, either. A student of engineering can, by subscribing for WOOD-PRESERVING and buying the Proceedings from the Secretary, get all that he needs from the Association for less money than it would cost him to enter. There are, however, connected with many wood-preserving plants employes who are interested in the work they are doing, and who will some day very likely acquire positions in their organizations that will permit them to be Corporate Members. They should be given an opportunity to feel from the very beginning that they may have an active interest in the Association. Therefore, the Probate Member is proposed, one who figures when he enters the Association that he is doing so with the idea of becoming a Corporate Member within a limited time, which has been set at five years. I move you that Article II, Section 1, be adopted.

MR. J. C. WILLIAMS: I second the motion.

THE PRESIDENT: Has anyone any objections, or does anyone want to discuss it? If not, those in favor of the motion will say Aye, opposed No. The Ayes have it.

MR. JOHN FOLEY: Article II, Section 2, provides for the same membership, if you agree that the language is such as to cover it, as

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was provided in the old Constitution, except that employes connected with the wood-preserving operations of telephone, telegraph and traction companies are covered; formerly they were not.

MR. J. C. WILLIAMS: Mr. President, this probably is splitting hairs a little bit, but I think we better be safe. The report permits a Corporate Member to be an executive or an operative in a wood-preserving organization. In the old Constitution we allowed administrative officers. Now, a strict interpretation to my mind of the new Constitution would be that the president, vice-president and secretary of a wood-preserving organization, also the retort foreman, could be a member, but the plant superintendent could not. I think that we ought to include the administrative officer in there the same as was done in the old Constitution.

Then we have also omitted the plant chemists. Now, we have several valuable members, members who have done work on committees, who have been plant chemists, and I think that it is to our advantage to retain those men and men of their caliber who will join our Association hereafter as Corporate Members.

Then we have a class of men I would denominate as inspecting engineers, who accumulate in time a great deal of valuable information in the way of formulating specifications for timber and so forth. They have previously been admitted as Corporate Members, and I think we should continue to admit them.

MR. JOHN FOLEY: My idea when writing this was that an operative of a plant is not only the individual who has charge of the cylinders. He is anybody whose decisions or opinions affect the operation of a plant, and that includes the chemist or the superintendent. I felt that we do not wish to be too exact in definitions, leaving them sufficiently broad, as all constitutional provisions should be, to give the administrative officers of the Association the chance to exercise their judgment.

With reference to the inspecting engineers, I assumed that they are used in a consulting capacity, and since the consulting chemical, civil, electrical, forest and mechanical engineers definitions would not be confined to men with engineering degrees, the capable inspector would be called an engineer, and in that way admitted to membership.

THE PRESIDENT: What is your pleasure, gentlemen?

MR. J. C. WILLIAMS: I move to amend that section by adding "administrative officers."

THE PRESIDENT: Is there a second to that motion?

MR. AUGUST MEYER: I second it.

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THE PRESIDENT: The motion is moved and seconded that we add to this Article II, Section 2, "administrative officers."

MR. JOHN FOLEY: That would then read:

> Shall be an executive, an administrator or an operative of a wood-preserving organization.

THE PRESIDENT: Are you ready for the question? Those in favor say Aye, opposed No. You are not very enthusiastic. Two voted Aye and one No; the Ayes have it (laughter).

MR. JOHN FOLEY: The change in Section 2 is merely to provide for the membership in the Association of organizations similar to our own. They were not taken care of before. I move that Article II, Section 3, be adopted.

MR. H. S. LOUD: I second the motion.

THE PRESIDENT: Has anyone anything to offer on this? If not, those in favor say Aye, opposed No. The Ayes have it.

MR. JOHN FOLEY: Section 4 is to take care of the members of inspecting organizations whom I believe a good many of our members do not consider quite sufficiently versed in wood preservation to become voting members, because in the work done by some of the inspectors they do not show that they know as much about wood preservation as treaters of wood think they might (laughter). I move that Article II, Section 4, be adopted.

MR. H. S. LOUD: I second the motion.

THE PRESIDENT: You have heard the motion. Are you ready for the question? Those in favor say Aye, opposed No. The Ayes have it.

MR. JOHN FOLEY: I move that Article II, Section 5, be adopted.

MR. L. B. MOSES: I second the motion.

THE PRESIDENT: You have heard the motion. Are you ready for the question. Those in favor say Aye, opposed No. The Ayes have it.

MR. JOHN FOLEY: I move that Article II, Section 6, be adopted.

MR. W. H. GRADY: I second the motion.

THE PRESIDENT: You have heard the motion. Are you ready for the question? Those in favor say Aye, opposed No. The Ayes have it.

MR. L. B. MOSES: I ask unanimous consent for a motion by Mr.

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Foley to adopt the balance of the Constitution as prepared by him en bloc.

MR. M. K. TRUMBULL: I second the motion.

MR. JOHN FOLEY: I appreciate the flattery of Mr. Moses' motion, but since this Constitution was written, and was very desirable, members who have given consideration to it have suggested changes which I believe should be given consideration by the meeting. If Mr. Moses has no objection, I would like to cover those particular points. If you will turn to Article II, Section 8, on page 3, you will find reference made to the Executive Committee. This is the first time it is referred to in the proposed Constitution, and some members have approached me with the suggestion that since the Executive Committee seemed to add another committee to the committees in the Association they would like to have that so-called committee termed a Board of Direction, or an Executive Board or Council. The terminology does not affect the Article in any way. The question is whether we shall continue to call the directing body in the organization an Executive Committee, a Board of Direction, or a Council.

THE PRESIDENT: What is your pleasure, gentlemen? Someone make a motion on that.

MR. H. S. LOUD: I move that instead of the expression "Executive Committee" the word "Council" be substituted.

THE PRESIDENT: Is there a second to that motion?

MR. A. R. JOYCE: I second that motion.

THE PRESIDENT: You have heard the motion. Are you ready for the question?

THE PRESIDENT: Read it the way it will read now.

MR. JOHN FOLEY:

> Probate Members shall have all the rights of Corporate Members, except those of voting or holding office, for five years from the date of their admission, when their status shall be determined by the Executive Committee.

We would merely substitute the word "Council" for "Executive Committee."

THE PRESIDENT: Are you ready for the question? Those in favor say Aye, those opposed No. The No's have it. It stands as it is.

MR. H. J. von LEER: I believe that motion would pass if you would just substitute the words "Executive Committee" for "Council," as far as I can see.

THE PRESIDENT: We have got it Executive Committee now.

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MR. JOHN FOLEY: The Council is not in existence now. The proposal is to change "Executive Committee" to "Council." Apparently few have enough interest in the title to care what it should be, and as Executive Committee it will remain. Is that clear to you now?

MR. H. J. von LEER: Yes.

MR. JOHN FOLEY: In Article IV, Section 3, on line 5, a provision is made to punish delinquents, and instead of the words "to vote and to receive," we believe it better to say "to vote or to receive."

THE PRESIDENT: If there are no objections we will accept that and pass to the next one.

MR. JOHN FOLEY: In Article V, Section 1, providing for officers, a third vice-president has been omitted, in the belief that we do not need quite so many officers. It has been suggested that the President be elected from the vice-presidents. It occurs to me that it would be better not to do so, though it would be desirable to choose him from the Executive Committee. If it is understood in advance that a vice-president is to be President, the electioneering is, of course, merely transferred from one office to the other. It makes practically the same proposition we have today. But if we can provide for him to come out of the Executive Committee, that insures an officer who has had contact with the business of the Association, and forces the politicians to work for 11 men instead of one.

THE PRESIDENT: I want to ask you a question. According to this Constitution, as you have revised it, are the first and second vice-presidents members of the Executive Committee?

MR. JOHN FOLEY: Yes.

THE PRESIDENT: Well, that leaves it all right. No objection to that.

MR. JOHN FOLEY: There should be added to the clause as you find it printed a final sentence which would say:

> The President shall be chosen from the nine eligible members of the Executive Committee.

THE PRESIDENT: Is there any place in the Constitution and By-laws where it states who the executive officers are?

MR. JOHN FOLEY: Yes. Article V.

THE PRESIDENT: In some organizations the vice-president is not a member of the Executive Committee.

MR. JOHN FOLEY: In this organization he has been, and is continued as such.

THE PRESIDENT: All right.

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MR. JOHN FOLEY: I move that Article V, Section 1, be adopted as printed, with the addition of the sentence:

The President shall be chosen from the nine eligible members of the Executive Committee.

MR. FRANK W. CHERRINGTON: I second the motion.

THE PRESIDENT: Are you ready for the question:

THE MEMBERS: Question, question.

THE PRESIDENT: Those in favor say Aye, opposed No. The Ayes have it.

MR. J. C. WILLIAMS: Mr. President, we slipped over something here that we ought to give a little attention to, I think. Article III, Section 4, provides for the expulsion of members for unbecoming conduct. Now, I think we ought to stiffen that up a bit. Twenty is a quorum, and 14 out of 20 would expel a member, and there are 11 members on the Executive Committee. I think we ought to keep this pretty democratic, and I think it would be advisable to change that Section 4, so that it would require two-thirds of all the members of the Association to vote to expel.

THE PRESIDENT: Is there a second to that motion. No second to your motion.

MR. L. B. MOSES: I am very sorry to have to come back in this way, but I think there is a very important point overlooked here in Section 2, of Article II, in the matter of membership. I think we have barred a class of members that are extremely desirable to this Association, namely, the railroad men who buy and handle treated ties. For instance, Mr. Pooler is not here so I can mention his name. He would be barred. That is a class of men who, of course, that is vitally we must have here. I move a reconsideration of Section 2, Article II, and its adoption with the inclusion of the following words after the word "organization" in the third and fourth lines:

A railroad officer whose duties include the inspection, purchase or treatment of wood.

THE PRESIDENT: Can I suggest a word there? Put in distribution. Why not purchasing, distributing and inspecting?

MR. L. B. MOSES: That is all right.

A railroad officer whose duties include the purchasing, inspecting distributing or treating of wood.

MR. J. C. WILLIAMS: As long as we came back to that section I would like to know what became of the plant chemists. Were they put in or taken out?

THE PRESIDENT: They were considered officers at the plant.

MR. JOHN FOLEY: If Mr. Moses has no objection to public

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utilitity corporations, I would like to have him also include telephone companies.

MR. L. B. MOSES: Of course that would be better.

MR. E. B. FULKS: While we are back to this question, I unfortunately let it go by, I want to ask for information just what is included in a public-utility corporation?

MR. JOHN FOLEY: Telephone, telegraph, trolley, water or other company that has service to sell to the public.

MR. E. B. FULKS: How about a gas company?

MR. JOHN FOLEY: A gas company would be included.

MR. E. B. FULKS: Why should a man that is in the gas business be included?

THE PRESIDENT: They might want to get rid of some natural gas (laughter).

MR. JOHN FOLEY: If they used treated wood to such an extent that they were interested in wood preservation, I believe the Executive Committee would feel that they should have a right to membership.

MR. E. B. FULKS: And if they do not use wood but sell certain products for timber preservation, they might be included?

MR. JOHN FOLEY: Such would be included among the Associate Members who are interested in the sale of material.

THE PRESIDENT: Read it now.

MR. JOHN FOLEY:

> A Corporate Member shall be an executive, an administrator, or an operative in a wood-preserving organization; an officer of a public-utility corporation using treated wood whose duties cover the purchasing, inspecting, treating or distribution of such material; a chemist or an engineer in the employ of a city, county, state, nation, or public-utility corporation; a consulting chemical, civil, electrical, forest, or mechanical engineer; or a professor or an instructor in an institution of learning.

MR. E. B. FULKS: That puts a different phase on the public utility.

THE PRESIDENT: Did you make that as a motion?

MR. L. B. MOSES: Yes.

THE PRESIDENT: Who seconds it?

MR. A. E. LARKIN: I second the motion.

THE PRESIDENT: Gentlemen, you have heard the motion. Are you ready for the question?

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THE MEMBERS: Question, question.

THE PRESIDENT: Those in favor say Aye, opposed No. The Ayes have it.

Now, gentlemen, do not think that your President is in a hurry to get away from here. He can stay here a week, but let us get these right so we will not have to revise them next year. We will give you all the opportunity you want to discuss the Constitution and By-laws, but we are not going to waste any time. If you want to do business you have to be on your feet promptly.

MR. JOHN FOLEY: Article V, Section 2, I move that it be adopted as written, with the word "business" put before organization. We would not like to bar two members of the American Railway Engineering Association, as might be construed under this clause.

MR. F. D. MATTOS: I second the motion.

THE PRESIDENT: It is moved and seconded as read by Mr. Foley. Are you ready for the question?

THE MEMBERS: Question, question.

THE PRESIDENT: Those in favor say Aye, opposed No. The Ayes have it.

MR. JOHN FOLEY: Article V, Section 3, raises a question in connection with the election of the officers. We can, to begin with, strike out the words, "from the Corporate Members" because, under the eligibility rules, Article V, Section 1, no officers may be elected unless they are Corporate Members. The question whether this vote shall be by ballot at the annual meeting now comes up. Since this Constitution has been in the hands of the members who have thought on the subject, the suggestion has been made that we have a printed ballot, which shall be distributed prior to the meeting, and the ballots counted at the meeting.

THE PRESIDENT: What is your pleasure?

MR. JOHN FOLEY: If it be more satisfactory to the members to take up the subject of voting at the point where the question is most involved, we might pass to Section 3, where the term "annual meeting" is referred to for the first time. Some members would like to call this an annual convention. If somebody would make a motion to call it annual convention, we would have that question settled.

THE PRESIDENT: What is your pleasure? Do you want it meeting or convention?

MR. JOHN FOLEY: Let it stand as it is.

MR. F. J. ANGIER: I move that in Article V, Section 3, the words "annual convention" be substituted for "annual meeting."

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THE PRESIDENT: Is there a second to the motion?

MR. FRANK W. CHERRINGTON: I second the motion.

THE PRESIDENT: Now, are you ready for the question?

MR. W. H. FULWEILER: Strictly speaking, can you not have a convention without holding a meeting? Is not a meeting generally understood to be for the transaction of business, and the convention for the reading of papers?

THE PRESIDENT: If you were talking about Methodist meeting, or a Presbyterian meeting, I could tell you.

MR. W. H. FULWEILER: At an annual convention we may present papers, but at an annual meeting we transact business just as we are doing at this meeting now.

THE PRESIDENT: What is your pleasure?

MR. JOHN FOLEY: Mr. Fulweiler is correct in saying you might have a convention without having a meeting. We have an Annual Meeting, and part of that meeting is what we are holding today. We may have meetings through the year at the call of the President. They would not be conventions. Our invitations to this meeting were issued for the Twelfth Annual Convention, and it is just a question in some people's minds whether we ought to stick to Convention.

THE PRESIDENT: What does Mr. Foley think?

MR. JOHN FOLEY: What I thought I put down here. I would like to stick to what we have so long, as it satisfies almost everybody (applause).

THE PRESIDENT: Are you ready for the question?

MR. H. J. von LEER: Why not put it at the business meeting of each annual convention, and let everybody be satisfied (laughter).

THE MEMBERS: The question.

THE PRESIDENT: The question is called for. Those in favor say Aye, opposed No. The No's have it.

MR. JOHN FOLEY: Section 7, of Article V, involves a change. It is the pleasure of the Association whether we shall let the presidents come back every other year or keep them out a little longer. I move that Section 7, of Article V, be adopted.

THE PRESIDENT: If there is no objection that will stand as printed.

MR. JOHN FOLEY: The only thing I fear about Mr. Moses' motion is that this Constitution may be railroaded through like constitutions have before, and result in amendments coming up next year or

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the year after. Although the time is short, I believe everybody should give consideration to this subject. If everybody is satisfied, we will go on.

In Article VI, Section 2, there has been a change at the suggestion of members who believe in more formal balloting or better representation of the membership. It has been said that at these business meetings there has been too small a collection of the voting membership, that half the members present voted, and so things have been handled without real expression of the wishes of the membership. You might ignore what is printed as Section 2, and get the new provisions, settling them. We can go back to the old one if these changes are adopted. Section 2:

> The Nominating Committee shall nominate one eligible member for each office and for each membership on the Nominating Committee and shall send its list of nominees to the Secretary-Treasurer before October 15. Any vacancies that may occur in the list of nominees before it is sent to the members shall be filled by the Executive Committee.

That merely provides that this Nominating Committee, instead of reporting to this convention, as it has in the past, shall have the names of its nominees in the hands of the Secretary by October 15, so that we may get them to the members.

MR. F. D. MATTOS: Mr. President, would not that cause considerable confusion, because we are distributed throughout the entire country? Unless you got members right in this particular locality, it would make it almost impossible.

THE PRESIDENT: I do not think you understand the point.

MR. JOHN FOLEY: You are going to have a chance just as now. You will get a ballot, which you can mark and send in to the Secretary long before you get it here, so whether or not you are at this meeting, you will get a chance to vote. At present you are not allowed the opportunity to vote if you are not here.

MR. A. R. JOYCE: Do I understand Mr. Foley to mean that the actual election of the officers will be held by a mail ballot?

THE PRESIDENT: Yes.

MR. JOHN FOLEY: Just as in organizations similar to our own.

MR. A. R. JOYCE: There would be no election at the Annual Meeting?

MR. JOHN FOLEY: The ballots will be counted by tellers at the Annual Meeting.

THE PRESIDENT: Read the entire section.

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MR. JOHN FOLEY:

Section 3. The voting shall not be restricted to the names presented by the Nominating Committee. Any member may file with the Secretary-Treasurer before November 1 the name of a candidate for any office.

Section 4. The ballot, with envelopes for secret voting, shall be sent to each member before December 1. It must contain the names of all nominees for each office, arranged alphabetically where there is more than one name for any office with the nominees of the Nominating Committee plainly indicated.

Section 5. Members may scratch or substitute the name of any nominee for any office.

Section 6. Ballots shall be sealed and sent or delivered to the Secretary-Treasurer before the polls close, prior to which time a voter may withdraw or replace his ballot.

Section 7. The polls shall be closed at noon on the first day of the Annual Meeting, and the ballots shall be counted by one Corporate and four Associate or Probate Members, appointed tellers by the presiding officer at the Annual Meeting.

Section 8. The persons who receive the highest number of votes for the office for which they are candidates shall be declared elected. In case of a tie between candidates for the same office the members present at the Annual Meeting shall elect the officer from the candidates so tied. The presiding officer shall announce to the meeting the names of the officers elected.

THE PRESIDENT: Now, you have heard it read in its entirety. What is your pleasure?

MR. E. B. FULKS: Mr. President, may I ask another question? I gather from his reading that a Nominating Committee nominates a ticket, which is sent in before October 15. Between that and November 1 anybody can nominate anybody by going through the prescribed formula, and then these names are placed on a ballot, which is sent out in alphabetical order.

MR. JOHN FOLEY: That is only provided in case you nominate somebody and the Nominating Committee nominates somebody.

MR. E. B. FULKS: That is what I mean.

MR. JOHN FOLEY: Those two names shall be arranged alphabetically.

MR. E. B. FULKS: Here is my point. The Nominating Committee nominates for Vice-President Mr. X., and somebody nominates Mr. A. They go out simply as Mr. A. and Mr. X. Nobody knows which one is the candidate of the Nominating Committee. The object of a Nominating Committee, as I have always understood, is to provide a ticket which they think is a strong one, and will provide the officers of the proper caliber, properly qualified to run the Association, and it is generally supposed that the weight of the Nominating Committee behind this ticket is of considerable importance. An individual member can carelessly insert the name of a man, and the object of the Nominating Committee is lost.

THE PRESIDENT: Just a minute. Will you read that?

MR. JOHN FOLEY: I see Mr. Fulks' point is well taken, and

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one that should be considered. It could be provided for by arranging it that the candidates of the Nominating Committee shall be designated. We can put an asterisk or any other kind of a mark on the ballot to designate the nominees of the Nominating Committee.

MR. E. B. FULKS: That is my point, and I think that is very important.

MR. A. L. KUEHN: Mr. President, I think that the Nominating Committee's candidates should be printed on the ballot.

THE PRESIDENT: That is what he is going to do.

MR. A. L. KUEHN: You can have a notation on the ballot. "If you wish to vote for anybody else, write the name down for the office that you want."

MR. JOHN FOLEY: That is provided, Mr. Kuehn, by saying that members may scratch or substitute. You can put a name on if you wish.

THE PRESIDENT: If you want to be President, and they do not nominate you, you can write to each member of this Association and ask him to vote for you, and if they nominate me, why, they can just cut Mr. Waterman out and put in Kuehn, and you wil be elected.

MR. A. L. KUEHN: No, I do not believe I would (laughter).

MR. JOHN FOLEY: To answer Mr. Fulks' very good suggestion, would it be satisfactory to say:

> The ballot, with envelope for secret voting, shall be sent to each member before December 1. It must contain the names of all the nominees for each office, arranged alphabetically where there is more than one name for any office, with the nominees of the Nominating Committee plainly indicated.

MR. E. B. FULKS: Yes, and the designation should be such that the man getting it knows what it means.

MR. JOHN FOLEY: I think it can be assumed that the Executive Committee will arrange the ballot in such a manner that everybody will know.

MR. E. B. FULKS: The point is to emphasize the fact that this man is the nominee of the Nominating Committee.

THE PRESIDENT: Any more questions? Any more suggestions?

MR. A. L. KUEHN: I may not understand this thing right, but I think we should limit the Nominating Committee to one nominee for the principal officers.

THE PRESIDENT: How are you going to do that, Mr. Kuehn? As revised it provides for nine members of the Nominating Commit-

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tee. Say five are in favor of John Smith and four are in favor of John Brown. Now, those four have a right to show Brown on the ticket, and the ticket should read a majority of the Nominating Committee says so and so.

MR. A. L. KUEHN: The American Railway Engineering Association nominates one man for President and another man for Vice-President, and so on the Nominating Committee handle this the same as any other committee handles any question that comes before it. The majority of the Nominating Committee will rule. Now, it might be well to nominate more than the required number of the members of the Executive Committee, so that there would be some choice, but we ought to have a good Nominating Committee and depend on them. They will be governed by the rule of seniority, and should have for the principal officers, the President, Vice-President, Secretary-Treasurer, only one man on the ballot for each office. Then you can scratch the ballot after you get it.

MR. JOHN FOLEY: Section 2 provides that the Nominating Committee shall nominate one eligible member for each office. Is that what you wish?

MR. A. L. KUEHN: That is it, yes. What is this alphabetical arrangement?

MR. JOHN FOLEY: That is only in case somebody outside of the Nominating Committee nominates somebody. That makes a second candidate.

MR. A. L. KUEHN: But you are going to print those names on the ballot?

THE PRESIDENT: Yes.

MR. A. L. KUEHN: Let the fellow that wants somebody else scratch the ballot.

THE PRESIDENT: He may want to reach more members.

MR. A. L. KUEHN: Let him write to them. I think you are going to get the best results that way. I know that has been the experience of the American Railway Engineering Association, and it will lead to greater strength than this putting a lot of names. I will warrant you will have a dozen names. You will have Mr. A, B, C and so on down. Mr. A may have been suggested by one member, and a busy man will check the first man all the way down the list, and you will not get the real choice of the Association in doing it that way.

THE PRESIDENT: What is your pleasure, gentlemen?

MR. L. B. MOSES: I think you got a good workable arrangement, Mr. President, as submitted by Mr. Fulks. I move the adoption of the section as read and amended.

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MR. W. H. GRADY: I second the motion.

THE PRESIDENT: Restate the motion.

MR. JOHN FOLEY: I move that Article VI, as amended, being what I have read, and what Mr. Fulks has said, and Mr. Moses also, be adopted.

MR. E. B. FULKS: I second the motion.

THE PRESIDENT: Are you ready for the question? Those in favor say Aye, opposed No. The Ayes have it.

MR. JOHN FOLEY: The only other point that I can recall where there have been suggested changes offered is in connection with Article VIII, Section 1, Meetings. Objection has been made to the date on which these meetings have been held each year, some members desiring to go to the meeting of the American Society of Civil Engineers, and some desiring to go to other gatherings. It would be very well if we could have somebody make a motion providing for a fixed time or an inclusive time; that is, the meetings shall be held between two dates, if you wish, January 15 and March 15, or January 31 and April 15, or change it to a fixed date. Instead of the third Tuesday, make it the fourth Tuesday in January, or the second Tuesday.

THE PRESIDENT: What is your pleasure?

MR. C. N. FORREST: Mr. President, the annual meeting of the American Society of Civil Engineers is always held in New York on the third Wednesday of January. I believe our annual meeting has always been held on the third Tuesday, so that they overlap. As the American Society is the larger and older organization, it is perhaps up to us to change our meeting rather than to try to get that Association to change its meeting. I would suggest, therefore, that we make the date of our annual meeting a fixed date, but on the fourth Tuesday of January.

THE PRESIDENT: Do you make that as a motion?

MR. C. N. FORREST: Yes.

THE PRESIDENT: Is there a second to the motion?

MR. W. H. FULWEILER: I second the motion.

THE PRESIDENT: Read it the way it will read.

MR. JOHN FOLEY: Merely providing that the Annual Meeting at which the officers shall be elected and annual reports presented shall be held on the fourth Tuesday of January.

MR. W. W. LAWSON: I would like to say that the last part of the month or the first part of the month is generally a pretty bad time for a plant operator to get away; that is, reporting time. I do not think that the change will be well received.

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MR. H. J. von LEER: Mr. President, that same thing occurred to me and one other, too. If you would take any Tuesday in the month, I believe the second Tuesday in January would be the best, for this reason, anything we bring up here, any method or matter of business that would relate in any way to the American Society of Civil Engineers, the members of that Society who attend this Association's meetings, would then have a chance to bring up those topics in that larger organization later on. That is, we will get in first, whereas they being the larger organization, handling a greater amount of work, our suggestions might be brought up on their floor with the same strength as if they were presented here. I believe the second Tuesday would be a better meeting date. I think we ought to have our meeting first.

THE PRESIDENT: Gentlemen, is there any more discussion on this point? Are you ready for the question?

MR. H. S. LOUD: There is one other thing to be thought about. It seems to me that there will come times when possibly we may look forward to a meeting of this Association when we may not have as much to do as we have had in the past, and it might be desirable to have our convention take place simultaneously with some other convention in the same city, and thus enable the men of this convention to profit by the opportunity of attending the other. This might be taken into consideration in appointing a fixed meeting time. There might be a little leeway left there for the Executive Committee.

THE PRESIDENT: What is your pleasure?

MR. C. M. TAYLOR: Howson has a speech to make.

MR. E. T. HOWSON: Mr. Chairman, I just made a remark to Mr. Taylor that the January meeting of the American Society of Civil Engineers is not a technical meeting, as one of the men evidently understood, but is primarily for the transaction of business of interest to the Society, and for certain trips of inspection. For this reason it does not seem to me that meeting a week in advance of the meeting of the American Society of Civil Engineers would have any relation to their meeting. There are, however, a certain number of the members of this Association who are also members of the other association who would like to attend that meeting. For this reason I would like to support Mr. Forrest's motion.

MR. M. K. TRUMBULL: Mr. President, I think there is a little further thought that we might give to this question of conflict of dates as pertaining to those of our members interested in both associations. For instance, some of the members of the American Society of Civil Engineers might want to attend some of the meetings of this convention, but they give priority to the other. Of course, next year we will not have any trouble on this score, inasmuch as we are going to New

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York City, where the annual meeting of the American Society of Civil Engineers is held.

THE PRESIDENT: Are you ready for the question? Now, you are changing the date to the fourth Tuesday, Wednesday and Thursday of January, instead of the second Tuesday, Wednesday and Thursday. I want you all to appreciate that when you vote on it. Those in favor of the motion say Aye, opposed No. The Chair is in doubt. Those in favor stand on their feet. Only Corporate and Honorary Members can vote. The Secretary will count.

THE SECRETARY: Thirty.

THE PRESIDENT: Those opposed stand on their feet.

THE SECRETARY: Seventeen.

THE PRESIDENT: The motion is carried. What next, Mr. Foley?

MR. JOHN FOLEY: This Article also provides that the meeting shall be held "at such place as the Association at the previous meeting may designate." Some members think that either a meeting committee or the Executive Committee should decide; that the matter is not given sufficient consideration at these annual meetings. So to bring the question to a head, and to let those who believe that the present arrangement should be changed to discuss it, I move that Article VIII, Section 1, providing for the fourth Tuesday be adopted as corrected in that regard only.

THE PRESIDENT: Is there a second to that motion?

MR. J. C. WILLIAMS: I second the motion.

THE PRESIDENT: How will it read?

MR. JOHN FOLEY:

> An Annual Meeting, at which the officers shall be elected and all annual reports read, shall be held on the fourth Tuesday in January of each year at ten o'clock A. M., at such place as the Association at the previous meeting may designate.

THE PRESIDENT: Are you ready for the question? In other words, that stays just as it is now, doesn't it?

MR. JOHN FOLEY: Except for the fourth Tuesday.

THE PRESIDENT: Those in favor say Aye, opposed No. The Ayes have it.

MR. JOHN FOLEY: I inadvertantly slipped over in Article VII, Section 5, a provision that has involved discussion before, and in order that nobody may say that they overlooked it at this time, I believe that Article VII, Section 5, should at least be thought of for a few minutes. It is an attempt to improve the old Article VIII, Section 2, which has brought about acrimonious arguments regarding the theoretical pro-

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cesses and the exploitation of various things. It now provides that the Executive Committee may withhold, in whole or in part, discussions or other matters that it considers unfit; but stipulates that the person who thinks he is hurt can try to get the Association to change the action of the Executive Committee. Aside from that there are no other changes, I think, that need to be called to your attention so as to avoid Mr. Moses' motion being carried through without sufficient consideration.

I move that the Constitution as amended at this meeting be adopted.

MR. H. S. LOUD: I second the motion.

THE PRESIDENT: Is there any discussion on it? Are you ready for the question? Those in favor of the motion made by Mr. Foley say Aye, opposed No. The Ayes have it.

I am sure everybody appreciates the work that Mr. Foley has done; your President does, and I want to personally thank Mr. Foley for the work he has done. There is a lot of hard work (applause).

The full text of the Constitution as adopted is given in the opening chapter of this volume.

THE PRESIDENT: Now, the next order of business is the reports of committees. The Press Committee, have you anything to say?

MR. E. T. HOWSON: Nothing at present.

THE PRESIDENT: The Auditing Committee.

MR. JOHN FOLEY: Mr. Taylor and I have examined the accounts of the Treasurer and found them correct as reported by him.

MR. W. W. LAWSON: I move the report of the Auditing Committee be accepted and the Committee be discharged.

MR. FRANK W. CHERRINGTON: I second the motion.

THE PRESIDENT: You have heard the motion. Those in favor of the motion say Aye; those opposed No. The Ayes have it.

The next is the report of the Resolutions Committee. Mr. Moses, are you ready to resolve?

REPORT OF COMMITTEE ON RESOLUTIONS.

MR. L. B. MOSES: In the face of the complimentary expression of the President about this, I feel very much embarrassed. I asked him why he wished to have me on this committee and he said that my name naturally suggested itself at once, as the real purpose of the Resolutions Committee was to get rid of a lot of words without any meaning; in return for which we have omitted the customary resolution thanking the President for his work during the past year (laughter). Seriously, we have omitted all of the formal, stereotyped resolutions, believing that they serve no real purpose except to cumber up the record. We have just four very short resolutions.

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The third resolution is of course purely formal, the usual resolution of thanks to the non-members who have presented papers here. It is only proper to say that we have put it in this form because they are men of such high type that it is impossible for us to attempt any adequate expression of thanks for what they have done for us. We have felt that as a matter of respect the resolution should be limited to the usual form adopted for such occasions.

RESOLUTIONS ADOPTED.

No. 1. WHEREAS, No definite steps have yet been taken by this Association toward the preparation of a Manual on Wood-Preserving; and,

WHEREAS, The preparation of such a Manual is of vital importance to the success of this Association;

Resolved, That the officers elected for the ensuing year are earnestly urged to comply with Resolution No. 2, 1915 Proceedings, covering this subject.

No. 2. WHEREAS, Our magazine, WOOD-PRESERVING, is now passing through that difficult stage of early existence which has been the experience of practically all trade and technical publications; and,

WHEREAS, Such a magazine is of undoubted value to the industry, and is an excellent medium of communication between the members in the intervals between their annual meetings, and needs and deserves the support of the Association's members;

Resolved, That this publication be continued, and that, in respect to this magazine, each member is respectfully requested to sell his hammer and buy a horn.

No. 3. WHEREAS, The Twelfth Annual Meeting of the American Wood-Preservers' Association has been addressed by Mr. J. W. Kendrick, Dr. L. F. Shackelt and Prof. F. H. Newell upon subjects of interest and value to all members;

Resolved, That the thanks of the Association be conveyed, with a copy of this resolution, to each of the gentlemen named.

No. 4. WHEREAS, It is to the interest of this Association to be officially represented at meetings of Associations, Societies, etc., whose proceedings include subjects allied with wood-preserving;

Resolved, That a Conference Committee of not more than three members, with a member of the Executive Committee as Chairman, be appointed by the officers elected for the ensuing year;

Resolved, Further, That the Chairman of that Committee be instructed to report to the 1917 annual meeting of this Association his recommendation as to whether such Committee should be permanently continued.

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THE PRESIDENT: The next in order is the report of the Memorial Committee. Mr. Cooper is Chairman. Let us stand during the reading of the report.

(The Resolutions prepared by the Memorial Committee are given on succeeding pages together with a short biographical sketch of the deceased members.)

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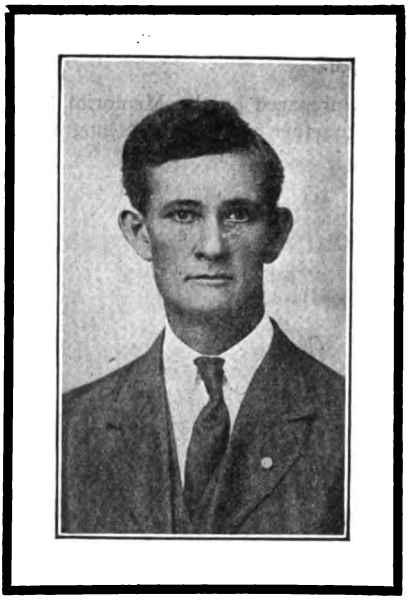

ALBERT C. PACE

BORN APRIL 3, 1877. DIED MARCH 15, 1915.

Albert C. Pace was born in Montgomery, Texas. In 1897 he entered the Baggage Department of the Santa Fe Railway Co. at Houston, Texas, and in the same year was transferred to Somerville, Texas. Later he entered the employ of the Ayer & Lord Tie Co., which operated the tie-treating plant at Somerville, and in 1898 was made foreman. In 1906 this plant was turned over to the Santa Fe Railway Co., and operated as the Texas Tie & Timber Preserving Co., which title was later changed to the Santa Fe Tie & Lumber Preserving Co. In 1907 Mr. Pace was appointed general foreman of this plant, and on Feb. 1, 1910, was promoted to Assistant Superintendent. On July 1, 1910, he was made Superintendent of the plant, continuing in this position until his death. Mr. Pace became a Corporate Member of the A. W. P. A. January 23, 1914.

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A. C. PACE.

WHEREAS, Death has taken from our midst during the past year our worthy member, A. C. Pace, Superintendent of the Santa Fe Tie and Lumber Preserving Co.'s plant at Somerville, Texas (Mr. Pace entered the service of the Santa Fe in 1897, and died in March, 1915. He rose from a subordinate position to the Superintendency of the plant, and won the respect of both his employes and employers, who deeply deplore his loss); and

WHEREAS, The deceased has manifested keen interest in the work of our Association, and at one time was a member of an important committee;

Resolved, That the American Wood-Preservers' Association tender to the relatives and business associates of the deceased their heartfelt sympathy in their bereavement; and,

Resolved, Further, That the Secretary forward a copy of these condolences to the family and business associates of Mr. Pace.

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LEWIS R. ARMSTRONG

BORN DEC. 31, 1860. DIED OCT. 15, 1915.

Lewis R. Armstrong, Vice-President and Treasurer of the T. J. Moss Tie Co., of St. Louis, died suddenly from heart disease. He was born at Aberdeen, Miss., attended high school, and when about 16 years old began work as a clerk and bookkeeper in a country store, advancing in a few years to head bookkeeper and assistant manager of one of the largest general stores in that vicinity. Mr. Armstrong went to St. Louis in 1885 as bookkeeper for the Allen-West Commission Co., and in 1893 became manager of the five commissary stores which the T. J. Moss Tie Co. was then running, with headquarters at Puxico, Mo. From this position Mr. Armstrong was advanced to Vice-President and Treasurer. He was enrolled as a Corporate Member of the A. W. P. A. October 12, 1914.

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LEWIS R. ARMSTRONG.

WHEREAS, Death has removed from our midst on October 15, 1915, our worthy member, Lewis R. Armstrong, Vice-President and Treasurer of the T. J. Moss Tie Co., (In 1893 he became manager of the stores, and from this position advanced to the position of Vice-President and Treasurer of the T. J. Moss Tie Co., his death being deeply regretted by his associates); and,

WHEREAS, The deceased has shown faithful interest in the affairs of our Association;

Resolved, That the American Wood-Preservers' Association tender to the relatives and business associates of the deceased their heartfelt sympathy in their bereavement; and,

Resolved, Further, That the Secretary forward a copy of these condolences to the family and business associates of Mr. Armstrong.

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HERBERT WHEELER COWAN

BORN APRIL 27, 1862. DIED MAY 29, 1915.

Mr. Cowan was educated at Worcester Polytechnic Institute, graduating with the degree of B. S. in 1882. For several years he practiced in municipal and architects' offices, and from 1883 to July, 1886, was employed by the Chicago, Burlington & Northern Railroad. Leaving this road in July, 1886, he was engaged by the Colorado Railway Co., resigning in September, 1888. Subsequently he entered the service of the Union Pacific Railroad as Assistant Engineer, remaining until 1894, when he became Resident Engineer for the Union Pacific, Denver & Gulf Railway. In February, 1899, he was appointed Chief Engineer of the Colorado & Southern Railway, and continued in this position until his death, which occurred at his home in Denver, Col. Mr. Cowan became a Corporate Member of the A. W. P. A. April 1, 1914.

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HERBERT W. COWAN.

WHEREAS, Death has taken from our midst during the past year our worthy member, Herbert W. Cowan, Chief Engineer, Colorado & Southern Railway; and,

WHEREAS, The deceased has always shown his loyalty to our Association and the industry it represents;

Resolved, That the American Wood-Preservers' Association tender to the relatives and business associates of the deceased their heartfelt sympathy in their bereavement; and,

Resolved, Further, That the Secretary forward a copy of these condolences to the family and business associates of Mr. Cowan.

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THE PRESIDENT: The next order of business is the report of the Nominating Committee.

THE SECRETARY: I have a message here to read.

THE PRESIDENT: The Secretary will read a message just received.

THE SECRETARY: This is from New York, Mayor Mitchell joins the Merchants' Association in inviting the American Wood-Preservers' Association to hold its convention in New York City. It is signed Theodore Rousseau, Secretary to the Mayor.

THE PRESIDENT: Tell him we will come if he will give us an address of welcome.

MR. J. B. CARD: I move Mr. Church send a telegram to him telling him we have selected New York as the next meeting place.

MR. J. C. WILLIAMS: I second the motion.

THE PRESIDENT: It is moved and seconded that Mr. Church send a reply message to the Mayor. Those in favor say Aye, opposed No. The Ayes have it.

We have just had resolutions, but here is a resolution that has been handed to me. I will ask the Secretary to read it.

THE SECRETARY:

To the Honorable A. R. Joyce, Chairman, and the Members of the Entertainment Committee:

We, the undersigned, wish to express our heartiest thanks and appreciation for the most excellent entertainment which you have provided for the ladies, your guests, at the Twelfth Annual Meeting of the American Wood-Preservers' Association. (Signed) Mrs. J. H. Waterman, Mrs. F. J. Angier, Mrs. F. D. Mattos, Mrs. F. H. Stewart, Mrs. M. M. Reyburn, Mrs. R. Van Metre, Miss Rose Ohlstone, Mrs. W. W. Lawson, Mrs. W. L. Bacon, Mrs. W. H. Clifton, Mrs. E. T. Howson.

THE PRESIDENT: What will you do with the resolution?

MR. J. C. WILLIAMS: I move it be turned over to the Entertainment Committee.

THE PRESIDENT: All right, we will turn it over to the Entertainment Committee.

Now the Nominating Committee. Mr. Van Metre has just asked me if under the new Constitution there are two or three vice-presidents, and I told him there were two. The Nominating Committee will report on the officers. We are ready for the report of the Nominating Committee.

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MR. R. VAN METRE: The result of our work was the selection of Mr. Carl G. Crawford for President, Mr. John Foley for First Vice-President, Mr. M. K. Trumbull for Second Vice-President, and Mr. F. J. Angier for Secretary-Treasurer; for members of the Executive Committee for the 3-year term, F. S. Pooler, A. R. Joyce and V. K. Hendricks; and for the six members of the Nominating Committee for 1916, E. B. Fulks, Lowry Smith, Frank McArdle, C. W. Lane, Walter Buehler and N. C. Brown.

MR. L. B. MOSES: Mr. President, it seems to me that the remarks that have been made about the weight which members should give to recommendations of the Nominating Committee could not be better exemplified than by the results of the work of this Committee. We have some interests to harmonize and a great deal of work to do. It seems to me that the officers recommended will fill the requirements, as well as any list that could have been selected. I ask unanimous consent to waive the usual rule and instruct the Secretary to cast the ballot of the Association for the nominees as read; and that the nominations be declared closed.

MR. H. S. LOUD: I second the motion.

MR. GEO. E. REX: I wish to second Mr. Moses' nomination, and it gives me pleasure to say that the men this Committee have nominated for our officers have been men that I have had the pleasure of working with for two or three years and I know they will be most earnest and conscientious and put forth their best efforts for the future of the Association.

THE PRESIDENT: Gentlemen, you have heard the motion. Is there anyone who has anything to say on it? Are you ready for the question?

THE MEMBERS: Question, question.

THE PRESIDENT: Gentlemen, those in favor of the question will stand on their feet. It is unanimous. Thank you.

Before this convention, Mr. Secretary, I cast the ballot for the men for officers and Executive Committee and Nominating Committee as presented by our present Nominating Committee (applause).

Mr. Fulks, will you escort the incoming President and Vice-Presidents to the platform?

MR. E. B. FULKS: With the greatest of pleasure.

(The President and Vice-Presidents were then escorted to the platform amid applause.)

EX-PRESIDENT WATERMAN: Mr. President, it is with a great deal of pleasure that I turn this gavel over to you. You will find

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a bunch of fine fellows to work with and I trust that they will give you the loyal support which they have given me in the past year (applause).

PRESIDENT-ELECT CRAWFORD: Gentlemen, I heartily thank you for the honor you have conferred upon me. I know you are all hoping that your President and incoming officers shall perform their duties in an efficient manner, and for myself I can say that I shall work earnestly and heartily to accomplish that end. It can only be accomplished, however, with the earnest and hearty support of each member of the Association, and I ask that support. I thank you (applause).

EX-PRESIDENT WATERMAN: Mr. Foley (applause).

MR. JOHN FOLEY: Mr. President, and gentlemen: This honor you have done me is appreciated, and I hope that what I am able to do in the way of furthering the interests of the Association during the year will amply repay you for the confidence you have reposed in me (applause).

EX-PRESIDENT WATERMAN: Mr. Trumbull (applause).

MR. M. K. TRUMBULL: Mr. President and members of the American Wood-Preservers' Association: You gentlemen are all aware of the honor you have conferred upon me. All I can do is to admit the fact, and to thank you most heartily. I will try to make up in earnestness what I lack in other respects to serve you to the best of my ability (applause).

EX-PRESIDENT WATERMAN: Mr. Secretary (hearty and prolonged applause).

MR. L. B. MOSES: What's the matter with Angier?

THE MEMBERS: He's all right.

MR. L. B. MOSES: Who's all right?

THE MEMBERS: Angier.

SECRETARY ANGIER: Mr. President, members and friends: I can only again thank you for the confidence you have placed in me, and I will try to do my work as I have done it in the past.

EX-PRESIDENT WATERMAN: Mr. President, can I say a word to the convention?

PRESIDENT-ELECT CRAWFORD: Yes.

EX-PRESIDENT WATERMAN: Gentlemen, we all have our hobbies. Mr. Rex had his hobby. I do not believe there will ever be a President that succeeds him that will get the number of members in this Association that he did. I had a hobby. My hobby is facts, tests, and we have had them before the convention. I had another hobby. I

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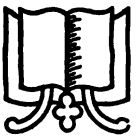
wanted to turn this convention over to my successor a harmonious whole. I want to say to you, Mr. President, that I predict for the coming year the most successful year that the American Wood-Preservers' Association ever had. Gentlemen, I again thank you for your hearty support (applause).

PRESIDENT-ELECT CRAWFORD: Is there anything further to come before the Association before it adjourns? If there is nothing further, we stand adjourned.



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STATISTICAL DATA

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QUANTITY OF WOOD PRESERVATIVES CONSUMED AND AMOUNT OF WOOD TREATED BY WOOD-PRESERVING PLANTS IN THE UNITED STATES IN 1915.

By R. K. Helphenstine, Jr., U. S. Forest Service.

The American Wood-Preservers' Association.
In Co-operation with the United States Department of Agriculture, Forest Service, Henry S. Graves, Forester; Office of Industrial Investigations,
H. S. Betts, Engineer in Forest Products, in Charge.

Summary.

In 1915 the 102 wood-preserving plants which operated during the year treated some 141,858,963 cu. ft. of material. The 1914 statistics on wood preservation were based on reports from 94 plants and showed a total of 159,582,639 cu. ft. treated. Although the figures for 1915 are based on the output of eight more plants than are those for 1914, the amount of wood treated in 1915 was less by 17,723,676 cu. ft., or 10%.

A notable increase, amounting to 1,986,286 cu. ft. was recorded in the amount of construction timber treated during the year. The number of cross ties subjected to treatment in 1915 was 37,085,585, a reduction from 1914 figures of 6,761,402, while the quantity of paving material was increased by over 300,000 square yards, or 11 per cent. Less than half as many cross-arms were treated in 1915 as in the previous year, and the quantity of piling and miscellaneous timbers treated fell below that reported in 1914 by 1,766,618 and 200,825 cu. ft. respectively, a decrease of 21% and 14%.

For the treatment of the 141,858,963 cubic feet of material reported in 1915, 33,269,604 lbs. of zinc chloride and 80,859,442 gals. of creosote were required. In addition 3,205,563 gals. of paving oil and 1,693,544 gals. of miscellaneous liquid preservatives* were consumed. In 1914 paving oil was reported separately for the first time, and amounted to 9,429,444 gals. In 1915 the treating plants reported only 3,205,563 gals. of this heavier oil, or considerably less than half the 1914 consumption.

Source of Statistics.

For each year in the past that these statistics have been collected reports from several plants were not secured. Formerly no estimates were included for such delinquents. For the 1915 compilation, however, approximations were made for five firms, which declined to furnish information but which are known to have operated during the

*Includes crude oil, coke oven-tar, refined coal-tar, carbolineum oils, corrosive sublimate, etc.

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year. These estimates were computed from the reports of plants of the same type and equipment, and it is thought their inclusion will make the statistics more complete.

The value of treated wood is more widely recognized by the consumers now than ever before, and statistics portraying the industry in all its phases are of great interest to those concerned in wood preservation. With the rapid advance of this industry as a whole, the choice of the kinds of preservatives has been fairly well established, but the kinds and classes of materials to be treated need development along certain lines. In Germany and other European countries practically all cross ties laid by the railroads are treated with chemicals or preserving oils. In this country but 30% of the ties purchased by the railroads are subjected to such treatment. The number of poles treated in this country is a very small per cent. of the total in use.

The report does not include data upon the consumption of preservatives or amount of material treated under methods which do not require the use of treating plant equipment. Consumers of this class are so numerous that it would be a difficult matter to secure such statistics. Most of the plants reporting are of the pressure-cylinder type. Approximately 64 of them are so called commercial plants which treat wood by contract, 30 are operated by railroads, and 8 are owned by mining companies or municipalities. Of the 127 plants of all kinds on the list of the Forest Service used in the compilation of the report 102 were active during the year, 14 discontinued operation, and 11 were temporarily closed down.

In 1915, as in previous years, the statistics were collected entirely by correspondence. All individual reports are considered confidential and totals are published only in such manner as will not reveal the operations of individual firms. The information furnished by the treating plants was of such a character that the report compiled from these data is the most complete and accurate so far published.

The objects in collecting the statistics are:

1. To show the progress of wood preservation in the United States.
2. To indicate the relative demand for the different preservatives in the various regions of the United States.
3. To show the amount of timber treated by species and classes of material as an aid for suggesting new fields of development for individual treating plants.
4. To show the quantities of imported and domestic creosote consumed, thus pointing out the principal sources of supply.
5. To present to consumers of lumber and other timber products the economy possible through the use of treated material.

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Consumption of Preservatives.

In Table I the consumption of wood preservatives used by the industry is given by years and kinds of preservatives. An increase of 10,000,000 gals. was recorded in each year for 1910, 1911, and 1912. The heaviest consumption of preservatives was reported in 1913. The total quantity of creosote reported for 1914 showed a decrease from the year previous of nearly 29,000,000 gals. Practically the same condition

TABLE 1.—CONSUMPTION OF WOOD PRESERVATIVES BY THE TREATING PLANTS IN THE UNITED STATES, 1909-1915.

Year	Number of Plants	Creosote. Gallons.	Zinc Chloride. Pounds.	Other Preservatives. Gallons*.
1909	64	51,431,212	16,215,109	†
1910	71	63,266,271	16,802,532	2,333,707
1911	80	73,027,335	16,359,797	1,000,000
1912	84	83,666,490	20,751,711	3,072,462
1913	93	108,373,359	26,466,803	3,885,738
1914	94	79,334,606	27,212,259	9,429,444‡ 2,486,637
1915	102	80,859,442	33,269,604	3,205,563‡ 1,693,544

*Includes crude oil, coke oven-tar, refined coal-tar and carbolineum oils.
†Statistics not available.
‡"Paving oil."

existed in 1915. In both years this drop in consumption was occasioned mainly by the decreased importation of German and English oil. The totals for the two years was also slightly affected by the fact that paving oil, formerly included in the total for creosote, was reported separately. The consumption of this oil in 1915 was 3,205,563 gals. and in 1914 9,429,444 gals.

During 1915 a total of 33,269,604 lbs. of zinc chloride was used by the treating plants in this country, an increased consumption of 6,057,345 lbs., or 20% over the amount employed in 1914.

The employment of miscellaneous oils for the treatment of wood was confined very largely to those plants situated in the Interior Eastern Region, because these oils are produced by local gas plants and at coke ovens and have the advantage of freight rates over creosote or zinc chloride, which must be transferred from distant producing points in the East and West.

Table II shows the monthly importation of creosote from England and Germany in 1914 and 1915. The total for 1915 indicates that the treating plants consumed slightly more foreign creosote than was recorded as imported into the United States. This may be accounted for by the fact that the plants did not consume all of the creosote purchased abroad during the year previous and the excess was used in

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1915. The fact that the consumption of domestic creosote was nearly doubled indicates marked activity on the part of manufacturers of this preservative in this country, and would tend to show a gradually decreasing dependence upon the foreign supply for American consumption. At the same time the tendency to use mixtures of coal-tar creosote and tar in this country is quite pronounced, and it is possible that the increase in the production of so-called domestic creosote is partly due to the large use of such mixtures.

TABLE II.—MONTHLY IMPORTS OF GERMAN AND ENGLISH CREOSOTE FOR 1914-1915.*

(*In Gallons.*)

Month	1914	1915
January	3,106,189	200,841
February	4,118,567	2,058,635
March	3,659,594	1,108,970
April	2,981,626	2,547,635
May	4,737,928	7,173,847
June	10,694,952	5,220,554
July	2,646,171	2,060,815
August	5,022,019	1,511,986
September	4,320,633	3,870,050
October	845,694	4,683,304
November	5,107,508	3,712,782
December	1,598,139	314,609
Total	48,839,020	34,464,028

*Monthly Summary of Foreign Commerce of the United States, Bureau of Foreign and Domestic Commerce.

The relative quantities of domestic and foreign creosote used in 1915 are shown in Table III. All foreign creosote was purchased from either English or German manufacturers. It will be noted from the table that the increased consumption of domestic creosote was counterbalanced by the decrease in the amount of the foreign preservative used.

TABLE III.—RELATIVE QUANTITIES OF DOMESTIC AND IMPORTED CREOSOTE USED IN THE UNITED STATES, 1909-1915.

Year	Total Creosote Used.	Domestic Creosote.	Per Cent of Total	Imported Creosote.	Per Cent of Total
	Gallons.	Gallons.		Gallons.	
1909	51,426,212	13,862,171	27	37,569,041	73
1910	63,266,271	18,184,355	29	45,081,916	71
1911	73,027,335	21,510,629	29	51,516,706	71
1912	83,666,490	31,135,195	37	52,531,295	63
1913	108,373,359	41,700,167	38	66,673,192	62
1914	79,334,606	28,026,870	35	51,307,736	65
1915	80,859,442	43,358,435*	54	37,501,007	46

*41,333,890 gals. coal-tar and 2,024,545 gals. water-gas creosote.

The price of domestic creosote in 1914 was approximately 8½c. per gal., f. o. b. plant, and that for zinc chloride 3c. per lb. Owing

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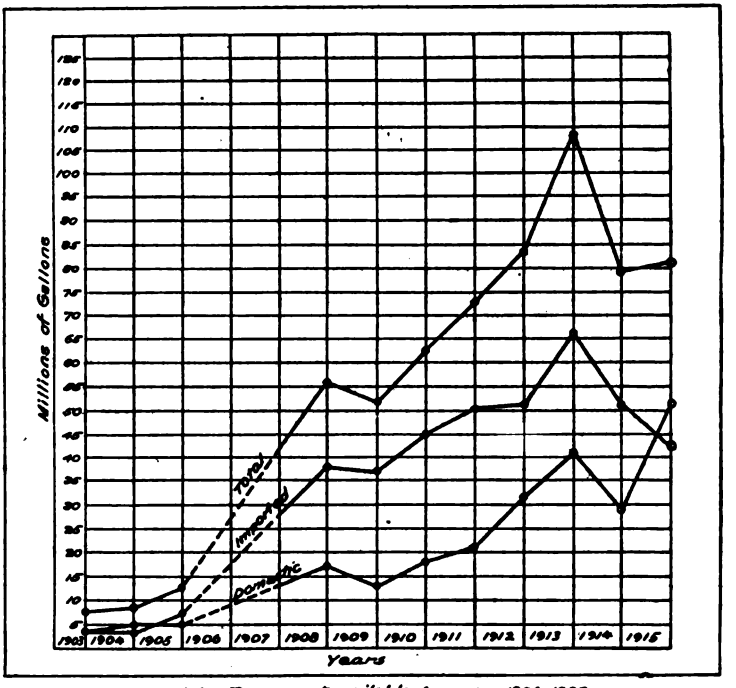
to the uncertainty of foreign shipments and the total lack of them at times during the past two years, the price of both kinds of preservatives has practically doubled. Corrosive sublimate used in the open-tank treatment of material has even more than quadrupled in price. Users of carbolineum oils report that foreign shipments of this preservative have been greatly curtailed, and the cost of both the foreign and domestic product has increased as a result.

PROGRESS OF WOOD PRESERVATION IN THE UNITED STATES

CONSUMPTION OF CREOSOTES FROM 1903—1915.



Note: Figures not available for years 1906-1907

OFFICE OF INDUSTRIAL INVESTIGATIONS
U.S. FOREST SERVICE

Regional Division of the Wood-Preserving Industry.

Table IV gives figures for five regions of the United States. These districts are indicated on the accompaning map. The consumption of wood preservatives and the kinds of material treated by the plants in these several regious is shown. The material is here shown in the

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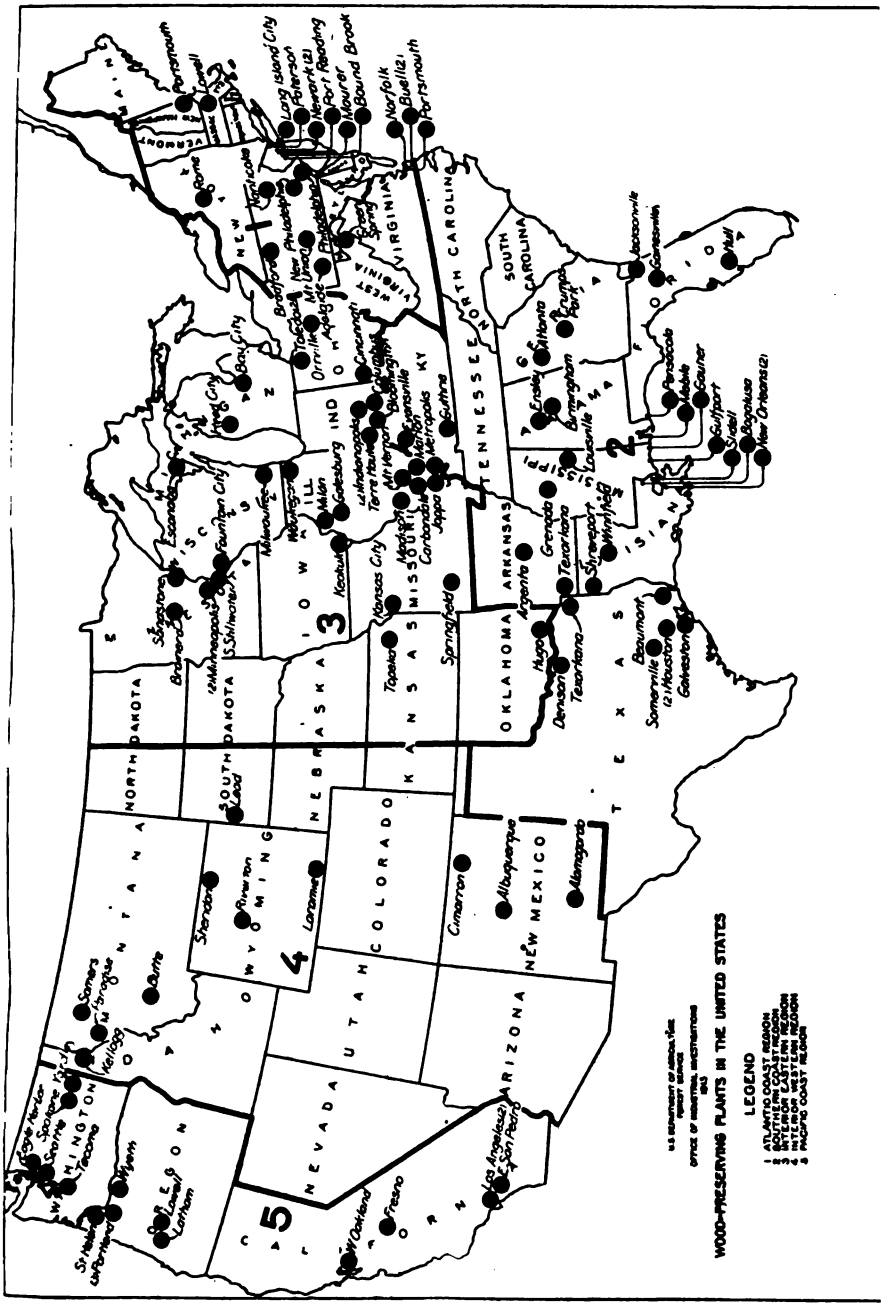
WOOD-PRESERVING PLANTS IN THE UNITED STATES
LEGEND
1 ATLANTIC COAST REGION
2 GULF COAST REGION
3 INTERIOR EASTERN REGION
4 INTERIOR WESTERN REGION
5 PACIFIC COAST REGION
U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
OFFICE OF FOREST UTILIZATION
1943
NORTH DAKOTA
SOUTH DAKOTA
NEBRASKA
KANSAS
OKLAHOMA
TEXAS
MONTANA
WYOMING
COLORADO
NEW MEXICO
ARIZONA
UTAH
NEVADA
WASHINGTON
OREGON
CALIFORNIA
MINNESOTA
IOWA
MISSOURI
ARKANSAS
LOUISIANA
WISCONSIN
ILLINOIS
MICHIGAN
INDIANA
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
PENNSYLVANIA
NEW YORK
MAINE
VERMONT
NEW HAMPSHIRE
MASSACHUSETTS
RHODE ISLAND
CONNECTICUT
NEW JERSEY
DELAWARE
MARYLAND
Seattle
Tacoma
Everett
Longview
Kelso
Vancouver
Portland
Salem
Albany
Coos Bay
Eugene
Grants Pass
Medford
Klamath Falls
Bend
Lakeview
Reno
Sparks
Carson City
Fallon
Winnemucca
Elko
Ely
Las Vegas
Boulder City
Henderson
Caliente
Pioche
Tonopah
Goldfield
Hawthorne
Yerington
Fernley
Lovelock
Battle Mountain
Austin
Eureka
Ely
Wells
Jackpot
Twin Falls
Boise
Nampa
Caldwell
Weiser
Lewiston
Moscow
Pocatello
Idaho Falls
Blackfoot
Rexburg
Driggs
Preston
Logan
Brigham City
Ogden
Salt Lake City
Provo
Orem
Spanish Fork
Price
Helper
Green River
Vernal
Roosevelt
Duchesne
Heber City
Kamas
Evanston
Kemmerer
Diamondville
Cokeville
Afton
Star Valley
Jackson
Pinedale
Big Piney
Marbleton
Lander
Riverton
Shoshoni
Thermopolis
Worland
Basin
Greybull
Cody
Powell
Lovell
Sheridan
Buffalo
Gillette
Newcastle
Upton
Sundance
Moorcroft
Hulett
Aladdin
Alva
Cheyenne
Wheatland
Torrington
Scottsbluff
Gering
Alliance
Chadron
Crawford
Harrison
Hemingford
Rushville
Gordon
Valentine
Ainsworth
Long Pine
Bassett
Atkinson
Stuart
O'Neill
Norfolk
Wayne
Hartington
Laurel
Wakefield
Allen
Dixon
Ponca
Hartington
Wynot
Coleridge
Wayne
Pender
Tekamah
Blair
Fremont
Omaha
Council Bluffs
Shenandoah
Clarinda
Red Oak
Creston
Corning
Shenandoah
Atlantic
Audubon
Harlan
Denison
Ida Grove
Sac City
Storm Lake
Cherokee
Le Mars
Sioux City
Sioux Rapids
Rockwell City
Fort Dodge
Webster City
Eagle Grove
Clear Lake
Mason City
Charles City
Waterloo
Cedar Falls
Independence
Oelwein
Decorah
Waukon
Postville
Elkader
Strawberry Point
Manchester
Dyersville
Dubuque
Galena
Freeport
Rockford
Belvidere
Harvard
Woodstock
Crystal Lake
Elgin
Aurora
Naperville
Joliet
Ottawa
Streator
La Salle
Peru
Princeton
Kewanee
Galesburg
Monmouth
Macomb
Rushville
Jacksonville
Springfield
Decatur
Mattoon
Effingham
Centralia
Carbondale
Cairo
Mt. Vernon
Olney
Robinson
Lawrenceville
Vincennes
Princeton
Evansville
Boonville
Tell City
Jasper
Huntingburg
Ferdinand
Dale
Rockport
Owensboro
Henderson
Madisonville
Hopkinsville
Clarksville
Dover
Nashville
Gallatin
Lebanon
Cookeville
Crossville
Harriman
Knoxville
Morristown
Greeneville
Johnson City
Kingsport
Bristol
Abingdon
Wytheville
Pulaski
Radford
Christiansburg
Roanoke
Lynchburg
Charlottesville
Culpeper
Fredericksburg
Richmond
Petersburg
Emporia
Suffolk
Norfolk
Portsmouth
Chesapeake
Elizabeth City
Edenton
Plymouth
Washington
New Bern
Morehead City
Wilmington
Whiteville
Fayetteville
Lumberton
Laurinburg
Rockingham
Hamlet
Cheraw
Florence
Darlington
Sumter
Camden
Kershaw
Lancaster
Chester
Rock Hill
Gaffney
Spartanburg
Greenville
Anderson
Seneca
Walhalla
Clemson
Greenwood
Abbeville
Edgefield
Aiken
Barnwell
Allendale
Hampton
Ridgeland
Beaufort
Walterboro
Summerville
Charleston
Georgetown
Conway
Myrtle Beach
Marion
Dillon
Bennettsville
Hartsville
Camden
Lancaster
Chester
Rock Hill
Gaffney
Spartanburg
Greenville
Anderson
Seneca
Walhalla
Clemson
Greenwood
Abbeville
Edgefield
Aiken
Barnwell
Allendale
Hampton
Ridgeland
Beaufort
Walterboro
Summerville
Charleston
Georgetown
Conway
Myrtle Beach
Marion
Dillon
Bennettsville
Hartsville
Florence
Darlington
Sumter
Camden
Kershaw

TABLE IV.—CONSUMPTION OF MATERIAL BY REGIONS FOR 1914 AND 1915.

Region	Year	Number of Plants	Domestic Creosote Gallons	Foreign Creosote Gallons	Zinc Chloride Pounds	Other Preservatives Gallons	Cross Ties		Piling Lin. Ft.	Poles Number	Paving Blocks Sq. Yds.	Construction Timber Bd. Ft.	Cross-Arms Number	Miscellaneous Bd. Ft.
							Hewed Number	Sawed Number						
Atlantic Coast	1914	18	9,258,016	14,630,982	1,978,930	60,503	4,583,859	1,236,319	3,134,993	14,312	626,713	30,023,227	318,469	5,607,600
	1915	20	12,277,532	17,959,083	2,077,877	50,080	5,339,088	2,089,847	3,500,821	11,697	552,095	28,298,805	16,757	4,634,655
Southern Coast	1914	24	5,262,778	24,622,198	4,169,271	.....	8,382,404	1,424,903	5,606,309	26,078	797,865	63,217,348	212,478	3,420,421
	1915	27	10,774,698	15,079,315	9,767,867	.....	8,519,038	439,255	3,817,927	66,216	806,968	77,798,523	121,945	3,658,227
Interior Eastern	1914	30	11,176,668	5,573,999	14,987,581	1,650,201	14,972,969	3,107,631	436,194	.....	1,128,494	13,009,636	.....	3,127,625
	1915	29	20,594,325	1,739,349	12,764,798	1,640,102	10,403,406	4,246,896	138,639	32,503	1,509,755	18,914,931	2,211	1,809,064
Interior Western	1914	10	1,517,734	1,679,066	4,278,783	.....	2,235,117	1,476,506	267,169	.....	.....	3,453,397	.....	1,946,300
	1915	10	1,809,854	585,557	6,441,138	.....	1,475,478	2,526,400	3,010	3,107	1,000	6,628,575	56	3,398,959
Pacific Coast	1914	14	811,674	4,801,491	1,797,694	29,809	47,834	7,209,123	3,032,517	32,012	63,831	7,968,925	.....	2,252,015
	1915	16	1.107,589	2,137,703	2,217,924	3,362	94,194	1,951,983	1,848,022	12,116	66,552	10,368,207	5,250	436,604
Grand Totals.	1914	94	28,026,870	51,307,736	27,212,259	2,126,349	30,222,183	13,624,804	11,920,601	72,402	2,616,903	118,220,904	547,582	16,353,961
	1915	102	43,358,435	37,501,007	33,269,604	1,693,544	25,831,204	11,254,381	9,308,419	125,639	2,936,370	142,009,041	146,219	13,937,509

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form and quantities as reported by the plants instead of in cubic feet as in Table VI.

The divisions shown were made with a view of conforming the areas embraced as far as possible to the Forest Service subdivisions into which this country's original forests have been divided. The divisons referred to are as follows:

1. *Atlantic Coast Region,* embracing the Northern Forest, made up largely of white pine, spruce, hemlock, tamarack and their associated species.

2. *Southern Coast Region,* which practically covers the territory included in the Southern Forest where the yellow pines predominate.

3. *The Interior Eastern Region,* comprising the Hardwood Forest, the only region in the United States where the hardwoods, such as oak, maple and beech, predominate.

4. *Interior Western Region,* coinciding with the Rocky Mountain Forest, throughout which western yellow pine occurs in company with lodgepole pine, larch, and other softwods.

5. *Pacific Coast Region,* the area covered by the Pacific Forest, where conifers such as Douglas fir, redwood, and western yellow pine occur almost to the exclusion of hardwoods.

Consumption of Preservatives and Treatment of Material by Regions.

Atlantic Coast Region.

The plants of the Atlantic Coast Region consumed the largest quantity of creosote during 1915 and the least amount of zinc chloride. The amount of foreign creosote used exceeded the domestic consumption by approximately 5,500,000 gals. The quantity of miscellaneous lumber treated exceeded that of any other region. Two million more cross ties were treated in 1915 than in the previous year, but the quantity of piling, construction timbers and paving blocks remained about the same. Less than one-nineteenth of the number of cross-arms treated in 1914 were reported by the plants of this region for 1915, while the number of poles treated showed a reduction of nearly 3,000.

Southern Coast Region.

This region was second in 1915 in the consumption of creosote, 10,000,000 gals. being of domestic manufacture and 15,000,000 gals. purchased abroad. The next largest amount of zinc chloride used can be credited to the plants of this region also, while no miscellaneous preservatives at all were reported.

The region leads in the amount of construction timbers subjected to preservative treatment, the total quantity being nearly 78,000,000 board feet, or more than 50% of the total material of this class reported. The number of poles treated during the year was twice as many as were reported for 1914.

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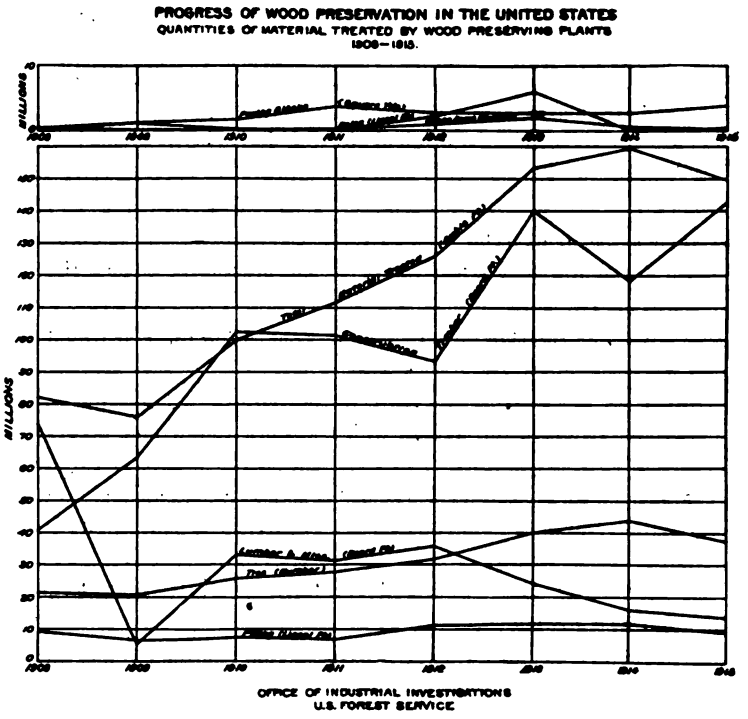

The plants of this region also report the treatment of approximately 9,000,000 ties, 3,500,000 lin. ft. of piling, 66,000 poles, 806,000 sq. yds. of paving blocks, 121,000 cross-arms and 3,500,000 board feet of miscellaneous lumber.

Interior Eastern Region.

The plants included in this area were the largest consumers of both domestic creosote and zinc chloride, more than 20,500,000 gals. of the former and over 12,500,000 lbs. of the latter being used. Over 14,000,000 cross ties were subjected to treatment. This was twice the number reported from the Atlantic Coast Region, but 25% less than the quantity treated in 1914. The region leads in the quantity of paving material handled, and showed the largest consumption of miscellaneous preservatives. Over 5,000,000 more bd. ft. of construction timbers were treated in this region this year than were shown in the report for 1914.

The plants of this region treated 32,000 poles and 2,200 cross-arms during 1915, whereas none were treated in the year before. A portion of the large amount of preservatives consumed was employed to

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lengthen the life of over 1,500,000 sq. yds. of paving blocks, and 138,639 lin. ft. of piling.

Interior Western Region.

The plants of this region in 1915 used 1,809,854 gals. of domestic creosote, or over three times their consumption of foreign creosote. They ranked third in the matter of zinc chloride consumption for the year. The ten plants reporting treated 6,628,575 bd. ft. of construction timber, or double the amount reported in 1914. No poles or paving blocks were treated in 1914, but the 1915 statistics show 3,107 of the former and 1,000 sq. yds. of the latter. The plants showed for the year an increase of 1,000,000 bd. ft. of miscellaneous lumber treated, while the number of ties run through the cylinders was about the same for both years.

Pacific Coast Region.

The consumption of creosote by the plants of this region was only 60% of the amount used in 1914. The plants report a total consumption of 3,245,292 gals., over half of which was of foreign manufacture. An increase in the zinc chloride used was recorded which amounted approximately to 400,000 lbs. Over 6,000,000 less cross ties were treated by the plants of this region in 1915 than for 1914. In this connection it is interesting to note that approximately this same quantity constituted an increase last year over the figures given in the 1913 statistics.

A total of 66,552 sq. yds. of paving material was treated during the year, affecting a slight increase over the 63,831 sq. yds. reported in 1914. Reductions in the amount of piling and miscellaneous lumber were recorded, however, the former being over 1,000,000 lin. ft., and the latter 1,500,000 bd. ft. less than for the previous year. The amount of structural timbers treated increased from 7,968,925 bd. ft. in 1914 to 10,368,207 bd. ft. in 1915.

Preservation of Ties.

A total of 37,085,585 cross ties was treated by the reporting plants in 1915. This is 6,761,402 less than the number given in the 1914 statistics. This decrease was greater for hewed than for sawed ties, the quantities for the two kinds being 4,390,979 and 2,370,423, respectively. Of the total quantity reported, 25,831,204 were hewed and 11,254,381 sawed ties, or nearly 70% of the former and 30% of the latter.

Oak ties again took the lead in the number treated, and constituted 45.53% of the total number of all ties of all species reported. Yellow pine ties were second in importance, and constituted 23.03% of the total. Following yellow pine in the order of the number treated came Douglas

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TABLE NO. V.—NUMBER OF CROSS TIES TREATED, BY KINDS OF WOOD AND KINDS OF PRESERVATIVES, IN 1915.

Preservative.	Oak	Yellow Pine.	Douglas Fir.	Western Pine.	Beech.	Gum.	Tamarack.	Maple.	Birch.	Elm.	Other Species.	Total.
Creosote	7,365,673	5,243,516	787,247	301,581	2,469,202	1,650	390,017	36,626	173,916	.....	307,641	17,077,069
Zinc Chloride..	7,954,492	3,257,565	2,760,952	1,702,167	100,000	204,653	449,660	316	55	50,846	1,338,578	17,819,284
Zinc Chloride and Creosote.	1,565,352	40,122	.....	3,861	364,535	71,583	91,496	.....	.....	.....	45,763	2,182,712
Miscellaneous .	.....	.....	5,655	.....	.....	.....	865	.....	.....	.....	.....	6,520
Total	16,885,517	8,541,203	3,553,854	2,007,609	2,933,737	277,886	932,038	36,942	173,971	50,846	1,691,982	37,085,585
Per cent of total Treated..	45.53%	23.03%	9.58%	5.42%	7.91%	0.75%	2.51%	0.10%	0.47%	0.14%	4.56%	100.00%

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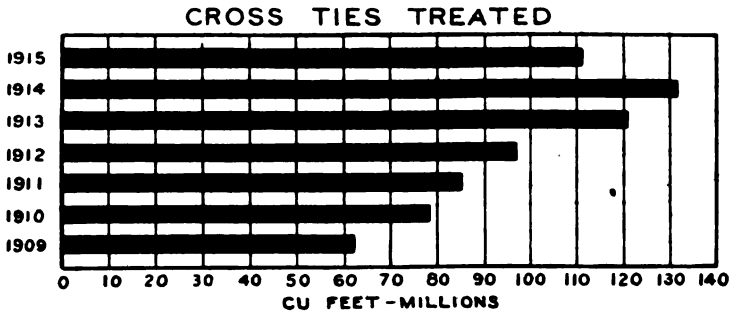
fir, western pine, beech, gum, tamarack,* maple, birch, and elm. The miscellaneous ties reported consisted of cypress, ash, sycamore, locust, and hickory, and amounted to 4.56% of the number treated.

The number of ties treated with zinc chloride and creosote in combination was 2,625,681, over 50% of which were of oak. The quantity of ties impregnated with miscellaneous preservatives in 1915 was 6,520 or 2,619,161 less than was reported in 1914. In using zinc chloride for the treatment of ties the average injection of the preservative was 0.5 lbs. per cubic foot, while with creosote oil an average of 8.5 lbs. per cubic foot was forced into the wood.



Preservation of Poles.

It is estimated that the number of treated poles reported by the plants throughout the country would constitute only half the total number actually subjected to treatment. The difference can be accounted for by the fact that a great quantity of poles is treated merely by dripping or by painting (brush treatment). This report, however, includes only those poles which were treated in cylinder or open-tank plants. A total of 125,639 poles was treated in 1915 as compared with 72,402 reported in 1914. These poles ranged in length from 20 ft. to 50 ft., approximately 55% being under 30 ft., 35% 30 ft. and under 40 ft., and 10% 40 ft. and over.

Sufficient detailed information as to species and treatment was not furnished by the plants to warrant a tabulated presentation of pole statistics. From data published in the 1913 report, taken from a table prepared by the Forest Service and the Bureau of the Census, entitled "Poles Purchased," it is apparent that the less durable woods are not being utilized to any great extent. By proper treatment less durable local woods can be made to last as long as untreated durable species, which, because of the cost incurred by long hauling, are more expensive.

*Includes western larch.

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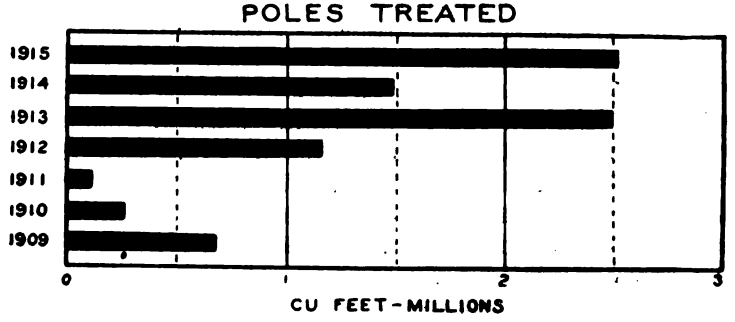
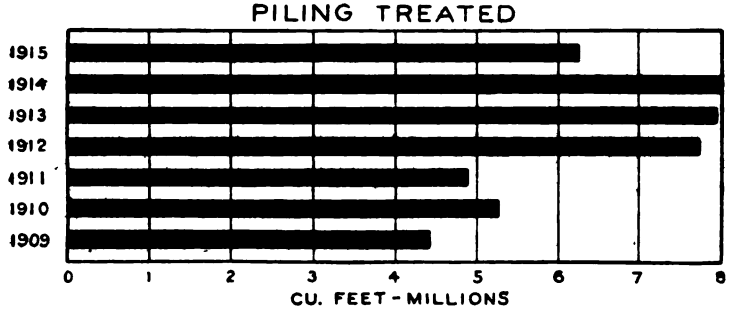
In treating poles in 1914 creosote was the principal preservative used. Yellow pine comprised 85% of the total, followed by western red cedar and Douglas fir. The absorption was about 11 lbs. per cubic foot.

Rueping, Bethel and open-tank processes were employed. The open-tank plant treats the butts only, and consequently a saving is made in the preservatives consumed, which permits a lower cost of the treated poles to the consumer.



Preservation of Piling.

During 1915 there was treated in the plants of this country 9,308,419 lin. ft. of piling, an amount less than that reported in 1914 by 2,612,182 lin. ft. Of the total quantity treated 3,817,929 were reported by the plants of the Southern Coast Region, and 3,134,993 by those located in the Atlantic Coast Region. A marked decrease occurred in the Interior Western Region, where only 3,010 lin. ft. of piling were treated in 1915, as compared with 267,169 lin. ft. reported the previous year. Though not as great, a similar reduction in piling treated in 1915 occurred in the Interior Eastern and the Pacific Coast Regions. The piling reported was principally yellow pine and Douglas fir. A



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small quantity of oak piling was listed, however, and all material of this class ranged in length from 20 to 110 ft.

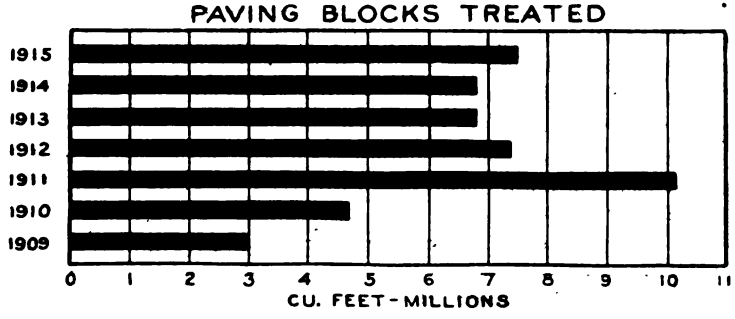
Creosote was employed in 90% of the plants, while in the balance zinc-creosote in combination and miscellaneous oils was utilized. Rueping and Bethel processes, using an average of 13 lbs. of creosote per cubic foot, were the common methods employed.

Preservation of Paving Blocks.

An increase of 319,467 sq. yds. of paving blocks was reported by the treating plants in 1915 over the quantity for 1914. The total for 1915 was 2,936,370 sq. yds. Slight increases in the amount treated in each of the four regions from which this class of material is reported went to make up most of the total increase, while 1,000 sq. yds. reported for a region where none were reported before supplied the balance.

A glance at Table IV will show the total amounts of paving material treated in each region during both the years of 1914 and 1915. Of the total amount of paving material treated 2,679,906 sq. yds. were of yellow pine, 204,465 sq. yds. of tamarack, 6,849 sq. yds. Norway pine, and 45,150 sq. yds. Douglas fir.

As was the case in 1914, all blocks were impregnated with oils, either creosote, paving oil, or a mixture of the two. The progress of the preservative treatment of paving blocks is shown in the accompanying diagram.



Preservation of Construction Timbers.

Bridge timbers, switch ties and other heavy structural material are included under this heading. In treating large timbers of this kind, the plants generally employ the two standard preservatives, creosote and zinc chloride, although in some establishments a mixture of the two is used.

The total amount of construction timbers impregnated during 1915 was 142,009,041, bd. ft., of which 77,798,523 bd. ft., or over 50% were

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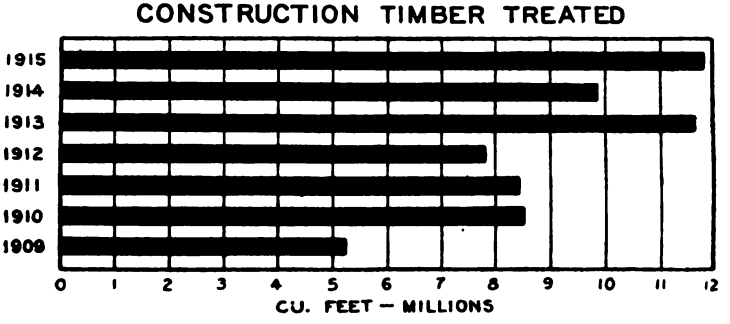
treated by the plants in the Southern Coast Region. The next largest quantity was reported from the Atlantic Coast Region, and amounted to 28,298,805 bd. ft. The material treated in the Pacific Coast Region is entirely Douglas fir. Yellow pine constituted practically all of the remainder reported. The average absorption per cubic foot of material was for creosote approximately 10.65 lbs., and for zinc chloride 0.5 lb.

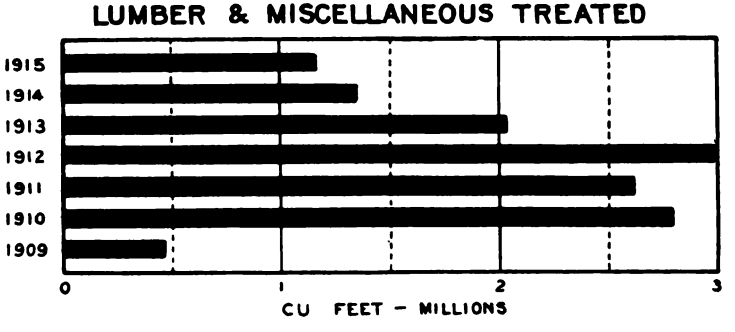


Miscellaneous Lumber.

Miscellaneous lumber includes tie plugs, shingles, stulls, wood pipe, and lumber.

The Atlantic Coast Region reported the largest amount of this class of material treated. The total for the region was 4,634,655 bd. ft. Next in order of importance were the Southern Coast Region with 3,658,227 bd. ft.; Interior Western Region, 3,398,959 bd. ft.; Interior Eastern Region, 1,809,064 bd. ft., and Pacific Coast Region, 436,604 bd. ft. The total for 1915 amounted to 13,937,509 bd. ft., or 2,416,452 bd. ft. less than was reported in 1914.

Creosote and zinc chloride were the preservatives used for this class of material, the former with an average impregnation of 10 lbs., and the latter 0.5 lb. per cubic foot.



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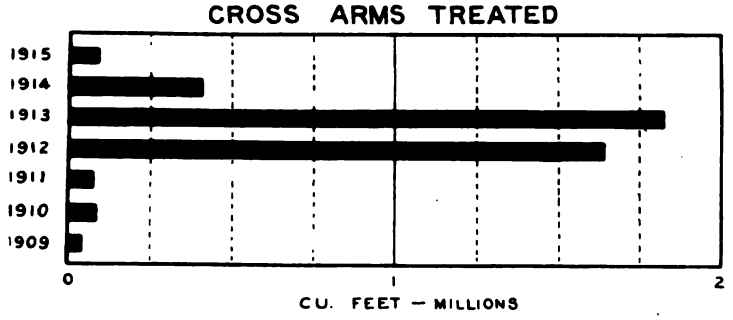
Comparative Statement of Material Treated.

Table VI is a summary statement showing the amount of material of each class which was subjected to preservative treatment during the years 1909 to 1915, inclusive. It gives the total amount of each kind



of commodity treated by the different preservatives employed, and records the development of the industry during the period covered. Cross ties constitute the major portion of all wood treated.

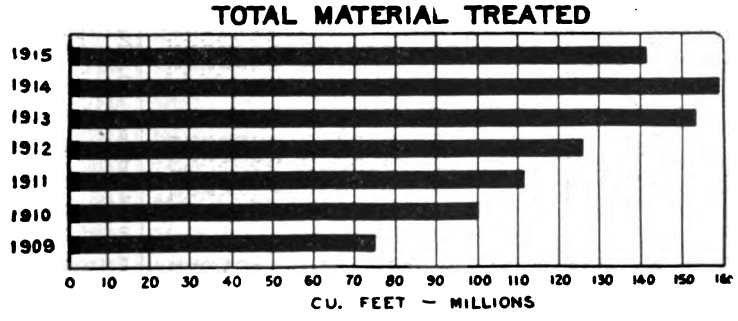


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TABLE VI.—COMPARATIVE STATEMENT OF MATERIAL TREATED IN THE UNITED STATES, 1909-1915, INCLUSIVE.

Preservatives.	Year.	Cross Ties. Cu. Ft.	Piling. Cu. Ft.	Poles. Cu. Ft.	Paving Blocks. Cu. Ft.	Construction Timbers. Cu. Ft.	Cross-Arms. Cu. Ft.	Lumber and Miscellaneous. Cu. Ft.	Total Material Treated. Cu. Ft.
Creosote	1909	29,830,080	4,421,726	659,664	2,994,290	4,902,311	41,764	417,787	43,267,622
	1910	44,525,229	5,219,254	255,597	4,692,453	7,801,272	88,069	2,687,713	65,269,587
	1911	49,532,163	4,937,363	106,213	10,145,724	7,417,105	71,961	2,499,995	74,710,524
	1912	57,461,515	7,624,939	1,169,981	7,091,658	6,892,493	1,643,128	2,841,195	84,724,909
	1913	75,998,307	7,630,328	2,367,769	6,810,308	10,308,883	1,813,010	1,853,993	106,782,598
	1914	67,774,329	7,804,657	1,188,511	3,127,506	8,389,158	395,403	1,348,566	90,027,630
	1915	51,231,207	6,288,238	2,336,318	1,174,319	9,264,164	87,373	981,028	85,115,647
Zinc Chloride	1909	24,153,162	a	a	a	320,891	a	2,333	24,476,386
	1910	27,587,583	a	a	a	541,514	a	71,060	28,200,157
	1911	28,337,883	a	a	a	1,043,851	a	119,931	29,501,665
	1912	28,532,874	a	18,246	a	259,972	a	20,092	28,831,184
	1913	36,051,816	a	47,996	a	585,756	a	7,670	36,693,238
	1914	50,020,755	a	b	a	1,317,925	a	4,355	51,343,035
	1915	53,457,852	4,726	a	a	2,406,150	a	275,279	56,144,007
Zinc Creosote	1909	8,095,794	a	a	a	62,918	a	43,699	8,202,411
	1910	6,354,219	38,392	a	a	181,143	a	30,646	6,604,400
	1911	7,312,374	b	a	a	b	a	b	7,312,374
	1912	8,214,303	97,874	a	a	560,613	a	99,367	8,972,157
	1913	6,938,838	327,594	a	b	758,989	a	53,628	8,079,049
	1914	5,868,834	a	a	b	140,718	a	b	6,009,552
	1915	6,548,136	2,320	110,220	a	40,396	a	4,822	6,705,894
All Preservatives	1909	62,079,036	4,421,726	659,664	2,994,290	5,286,120	41,764	463,819	75,946,419
	1910	78,467,031	5,257,646	255,597	4,692,453	8,523,929	88,069	2,789,419	100,074,144
	1911	85,182,420	4,937,363	106,213	10,145,724	8,460,956	71,961	2,619,926	111,524,563
	1912	97,183,009	7,737,035	1,188,579	7,397,095	7,793,524	1,643,128	2,988,686	125,931,056
	1913	120,781,248	7,957,922	2,500,420	6,856,293	11,653,628	1,824,719	2,039,658	153,613,888
	1914	131,540,961	8,061,902	1,482,407	6,869,370	9,847,801	417,914	1,362,284	159,582,639
	1915	111,256,755	6,295,284	2,512,780	7,707,971	11,834,087	90,627	1,161,459	141,858,963

NOTE.—Figures furnished by United States Forest Service. (a). No Statistics. (b). Figures, if used, would reveal identity of reporting firms.

CONVERTING FACTORS.

To obtain the number of cross ties, divide figures shown by 3.
To obtain the number of lineal feet of piling, divide the figures shown by .6763.
To obtain the number of lineal feet of poles, divide the figures shown by .5868.
To obtain the number of square yards of paving blocks, divide the figures shown by 2.625.
To obtain the number of board feet of construction timbers, multiply the figures shown by 12.
To obtain the number of cross-arms, divide the figures by .6198.
To obtain the number of board feet of lumber and miscellaneous material, multiply the figures shown by 12.

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MILEAGE OF STEAM, HORSE AND ELECTRIC RAILWAYS IN THE UNITED STATES.

Cross Ties Used and Treated—Treating Plants in Operation.

Year	Steam Railroads: First Main Tracks	Steam Railroads: Other Tracks	Horse & Elec. Rwys. Miles	Total Miles	Ties Used Number	Number Ties Treated	Percentage Treated	Treating Plants In Operation
1860	30626	3000	200	33826	10147800	From 1860 to		
1870	52922	9100	1200	63222	18966600	1885 inclusive	0.10	3
1880	93267	21977	2000	117244	35173200	Approx. 50,000		
1885	123320	32868	2800	158988	47696400	120000	0.25	5
1886	125185	34441	3120	162746	48823800	510000	1.04	5
1887	137028	37348	3680	178056	53416800	594000	1.11	5
1888	145387	38221	4112	187720	56316000	644000	1.14	6
1889	153725	42242	4930	200897	60269100	615000	1.02	7
1890	163597	42036	5241	213874	64168200	650000	1.01	8
1891	168403	47746	6155	222304	66691200	697000	1.05	8
1892	171564	50787	7040	229391	68817300	790000	1.15	9
1893	176461	53676	8870	239007	71702100	812000	1.13	10
1894	178709	54825	8949	242483	72744900	920000	1.26	11
1895	180657	56237	10810	247704	74311200	1289000	1.73	12
1896	182777	57352	12133	252262	75678600	1307000	1.73	13
1897	183284	58729	13765	255778	76733400	1312000	1.71	13
1898	184648	60686	15942	261276	78382800	1826000	2.33	13
1899	187535	62608	17665	267808	80342400	2510000	3.12	15
1900	192556	66228	19314	278098	83429400	2800000	3.36	15
1901	195562	69790	22217	287569	86270700	4101000	4.75	17
1902	200155	74041	25592	299788	89936400	6180000	6.87	22
1903	205314	78508	27754	311576	93472800	9010000	9.64	27
1904	212243	84830	29548	326621	97986300	12800000	13.06	30
1905	216974	89823	32517	339314	77982000	14890000	19.09	34
1906	222340	94643	36212	353195	102834000	16880000	16.41	39
1907	227455	100520	38812	366787	153700000	19856000	12.92	51
1908	233468	103152	40247	376867	112463000	23776000	21.14	57
1909	236834	106949	40490	384273	123751000	22033000	17.80	68
1910	240293	110936	40088	391317	148231000	30544000	20.60	75
1911	243979	116586	41088	401653	135053000	31141000	23.06	81
1912	246777	121386	42110	410273	123081900	32394000	26.32	87
1913	249777	126038	43043	418858	125657400	40260000	32.04	92
1914	252230	130661	43989	426880	128064000	43847000	34.24	95
1915	255000	135000	44500	434500	130350000	37085585	28.4	102

Mileage of steam railroads from 1890 to 1914 from records of Interstate Commerce Commission.

Cross ties used and treated from 1906 to 1911 from Census Reports.

Cross ties used from 1860 to 1905 and from 1912 to 1915 estimated on basis of 300 ties per mile.

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TIMBER USED ON CERTAIN RAILROADS.

The following information, collected by H. E. Horrocks, does not give service records, but is of value as showing the practice of certain railroads.

Railroad	Location	Do you use treated bridge & structural timbers as a general practice?	If treated timbers used only in special cases, what determines its use?	What kind of preservative do you use?	What species of timber do you use for bridge and structural purposes?	What quantity of preservative do you use per cubic foot of timber?	What preservative do you consider best / adapted to your conditions?	What process of creosoting do you use—as Open Tank Steam, Pressure, Boil, Empty Cell?	What maximum temperatures do you allow in creosoting treatment?	Do you treat your own timbers, or purchase in open market?	Kindly make any remarks you see fit as to service, suitability and your opinion of treated timbers for bridge and structural purposes.
Camas Prairie.....	Portland, Ore.....	NO	Teredo & Limnoria	Creosote	Fir Piles Bracing, etc.	12-16 lbs. Depending on Conditions	Creosote	Steam Vacuum	225° F	Purchase	....
Ore.-Wash. R. & N.	Portland, Ore.....	NO	Teredo & Limnoria	Creosote	Doug. Fir	12-16 lbs. Depending on Conditions	Creosote	Steam Vacuum	225° F	Purchase	....
San Joaquin Light & Power...	Los Angeles, Cal...	NO	Poles for Power Purposes	Creosote	Western RC Fire Killed	12 lbs.	Creosote	Open-Tank	220° F	Own Plant	Use Poles Only
San Pedro, Los Ang. & Salt Lake	Los Angeles, Cal...	NO	Contact with Soil	Zinc Chloride	Oregon Pine	.....	Zinc Chloride	Steam Vacuum 20"	150-160° F	Own Plant	Piling and Timber in contact with soil should be Treated
Anaconda Mining..	Anaconda, Butte...	YES	Dry Rot	Creosote	Pine Fir Larch & Cedar Poles	2½-3½ lbs. for Tbr. & Plg. 1½ Gals. for Poles	Creosote	Poles Open-Tank Fir-Steam & Boil. 70-85 lbs. Pine, Boil. 55-65 lbs.	170-220° F	Own Plant	Two to three times life of untreated mtl.
El Paso & S. Western.....	El Paso, Texas.....	YES	.....	Creosote	.....	10 lbs. & Rueping 5 lbs.	Creosote	Contract Work	....	Purchase on Contract	
Salt Lake & Ogden	Salt Lake, Utah.....	No Wooden Bridges—Use Treated Cedar Poles and Treated Fir Ties in Paved New York City Work									
Northern Pacific...	St. Paul, Minn.....	Special Cases	Teredo	Creosote	Doug. Fir	7-10 lbs.	Creosote	Boiling	225° F	Purchase	Trtd. Tbr. in Temp. Wk.
Pacific Coast.....	Seattle, Wash.....	Special Cases	Teredo	Creosote	Doug. Fir	12 lbs.	Creosote	Boil. and Steam	.....	Purchase	
Pajaro Valley Cons	Spreckles, Cal.....	NO	Teredo	Creosote	Doug. Fir	12 lbs.	Creosote	Boil. 24" Stm. 24"	225° F	Purchase	
C. M. & St. P....	Chicago, Ill.....	NO	Economy	Zinc Chloride	Doug. Fir S. Pine Wht. & Nor. Pine	12-16 lbs.	Creosote			Purchase	
Idaho & Wash. Northern	Seattle, Wash.....	NO	Economy	Creosote	Doug. Fir	12-16 lbs.	Creosote	Boil.-Steam	225° F	Purchase	
Great Northern.....	St. Paul, Minn.....	Ties-Steel Bridge		Carbolin'm		Brsh & Dip				Own Plant Car. & Zinc Chl.	
		Howe truss timbers		Carbolin'm		Brsh & Dip 12 lbs. Plg. 7 lbs. Tbr. & Blks.					
		Sub-planking & Blks.		Creosote Zinc Chloride				Boil.-Steam			
		Trnck Ties			Doug. Fir					Purchase	

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WOOD-PRESERVING PLANTS IN U. S., CANADA AND MEXICO, JAN. 1, 1916.

UNITED STATES.

PRESSURE PROCESSES.

Managing Company	Headquarters	Location of Plant	Year Built	Retorts. No.	Retorts. Diam. In.	Retorts. Length Ft.
American Creosoting Co.	New York, N. Y.	Newark, N. J.	1906	1	78	105
" " "	" "			1	78	165
" " "	Louisville, Ky.	Indianapolis, Ind.	1913	2	64	134
" " "	" "	Marion, Ill.	1907	2	84	134
" " "	" "	Springfield, Mo.	1907	2	84	134
" " "	" "	Kansas City, Mo.	1907	2	84	134
" " "	" "	Russell, Ky.	1915	1	84	134
" " "	" "	Hugo, Okla.	1907	2	84	134
Am. Creosote Works.	New Orleans, La.	Southport, nr. New Orleans	1901	1	84	172
" " "	" " "			1	108	172
		Louisville, Miss.	1912	1	108	172
Anaconda Copper Mining Co.	Butte, Mont.	Butte, Mont.	1910	1	72	43
A. T. & S. F. Rwy. Co.	Topeka, Kan.	Somerville, Tex.	1906	5	74	132
" " " "	" "	Albuquerque, N. M.	1908	2	74	132
Atlantic Coast Line R. R. Co.	Wilmington, Del.	Gainesville, Fla.	1912	2	74	138
Atlantic Creo. & W. P. Wks.	Norfolk, Va.	Norfolk, Va.	1901	1	78	62
				1	78	82
				1	78	126
Ayer & Lord Tie Co.	Chicago, Ill.	Grenada, Miss.	1904	4	74	128
" " " "	" "	Argenta, Ark.	1907	4	74	132
" " " "	" "	Carbondale, Ill.	1902	4	72	122
				4	74	132
Baltimore & Ohio R. R. Co.	Baltimore, Md.	Green Spring, W. Va.	1912	2	84	132
Barber Asphalt Paving Co.	Maurer, N. J.	Maurer, N. J.	1905	4	72	115
Boston Elevated Rwy. Co.	Boston, Mass.	South Boston, Mass.	1916	1	90	51
Buffalo, Rochester & Pitsburgh R. R. Co.	Rochester, N. Y.	Bradford, Pa.	1910	1	75	95
Bunker Hill & Sullivan Mg. Co.	Kellogg, Idaho	Kellogg, Idaho	1908	1	84	10
Carbolineum Wood Pres. Co.	Portland, Ore.	Portland, Ore.	1901	1	..	...
Central of Ga. R. R. Co.	Macon, Ga.	Macon, Ga.	1912	2	84	116
Charlotte Harbor & No. Ry. Co.	Boca Grande, Fla.	Hull, Fla.	1912	1	74	73
C. B. & Q. R. R. Co.	Galesburg, Ill.	Galesburg, Ill.	1907	5	74	132
" "	Chicago, Ill.	Sheridan, Wyo.	1899	2	74	132
Chicago Creosoting Co.	Chicago, Ill.	Waukegan, Ill.	1907	2	72	134
Chicago Creosoting Co.	" "	Terre Haute, Ind.	1912	2	132	20
Chicago & N. W. Ry. Co.	" "	Escanaba, Mich.	1903	3	72	112
" " "	" "	Riverton, Wyo.	1915	1	72	110
Colman, J. M., Co.	Seattle, Wash.	Seattle, Wash.	1884	3	75	120
Colonial Creosoting Co.	Louisville, Ky.	Bogalusa, La.	1912	2	72	134
Columbia Creosoting Co.	Portland, Oregon	Linnton, nr. P'tland, Ore.	1912	1	72	132
				1	72	65
Compressed Wood Preserving Co.	Cincinnati, O.	Cincinnati, O.	1909	2	72	76
Continental Tie & Lbr. Co.	Denver, Colo.	Cimarron, N. M.	1913	1	84	87
El Paso & S. W. R. R. Co.	El Paso, Tex.	Alamogordo, N. M.	1902	2	72	106
Eppinger & Russell Co.	New York, N. Y.	Long Island City, N. Y.	1878	4	72	100
" " "	" " "	Jacksonville, Fla.	1909	3	84	130

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Wood-Preserving Plants in U. S.—(Continued)

Managing Company	Headquarters	Location of Plant	Year Built	Retorts. No.	Retorts. Diam. In.	Retorts. Length Ft.
Federal Creosoting Co.	Louisville, Ky.	Bound Brook, N. J.	1909	1	84	150
" " "	" "	Toledo, O.	1909	3	84	134
" " "	" "	Rome, N. Y.	1910	2	84	150
" " "	" "	Paterson, N. J.	1909	1	84	150
Georgia Creosoting Co.	Louisville, Ky.	Brunswick, Ga.	1915	2	84	121
Great Northern Ry. Co.	St. Paul, Minn.	Somers, Mont.	1901	4	72	110
Gulfport Creosoting Co.	Gulfport, Miss.	Gulfport, Miss.	1906	2	84	120
Indiana Creosoting Co.	Louisville, Ky.	Bloomington, Ind.	1907	1	84	134
Indiana Tie Co.	Evansville, Ind.	Evansville, Ind.	1907	2	72	110
" " "	Evansville, Ind.	Joppa, Ill.	1909	2	72	110
Indiana Zinc Creosoting Co.	Terre Haute, Ind.	Terre Haute, Ind.	1904	2	72	120
Interstate Public Service Co.	Indianapolis, Ind.	Columbus, Ind.	1909	1	72	45
Int'l. Creo. & Con. Co.	Galveston, Tex.	Beaumont, Tex.	1892 1897	1	108	140
" " " "	" "	Galveston, Tex.	1905	1	72	100
" " " "	" "	Texarkana, Ark.	1902	1 1	114 72	165 125
Jennison-Wright Co.	Toledo, O.	Toledo, O.	1910	2	72	130
Kettle River Co.	Minneapolis, Minn.	Madison, Ill.	1909	4	84	135
" " "	" "	Sandstone, Minn.	1904	2	72	120
Louisiana Creosoting Co.	Winnfield, La.	Winnfield, La.	1906	1 1	72 72	126 80
L. & N. R. R. Co.	Louisville, Ky.	Guthrie, Ky.	1913	2	84	133
" " " " " "	" "	Gautier, Miss.	1895 1916	1 1 1	72 72 84	115 133 133
Michigan Pipe Co.	Bay City, Mich.	Bay City, Mich.	1893	1	72	42
Michigan Wood Preserving Co.	Pittsburgh, Pa.	Reed City, Mich.	1913	1	90	90
Mo., Kan & Tex. Ry. Co.	St. Louis, Mo.	Dennison, Tex.	1909	4	72	108
Moss, T. J., Tie Co.	" " "	Mt. Vernon, Ill.	1899	1 1	74 72	132 117
Nat'l Lbr. & Creo. Co.	Texarkana, Ark.	Texarkana, Tex.	1910	2	84	132
" " " "	" "	Houston, Tex.	1912	4	72	120
Norfolk Creosoting Co.	Norfolk, Va.	Buell (nr. Norfolk), Va.	1896 1905	4 1 1	78 78 84	100 105 125
Northern Pacific Ry. Co.	St. Paul, Minn.	Brainerd, Minn.	1907	2	84	134
Ohio Wood Preserving Co.	Pittsburgh, Pa.	Orrville, O.	1912	1	84	90
Oregon-Wash. R. R. & Nav. Co.	Portland, Oregon	Wyeth, Oregon	1904	4	72	114
Pacific Creosoting Co.	Seattle, Wash.	Eagle Harbor, Wash.	1906	8	73	125
Pennsylvania R. R. Co.	Philadelphia, Pa.	Greenwich, Pa.	1910	2	72	132
" " "	" "	Mt. Union, Pa.	1909	1	72	132
P. & R. R. R., C. R. R. of N. J.	Port Reading, N. J.	Port Reading, N. J.	1912	2	88	140
Pioneer Lbr. & Creo. Co.	Ensley, Ala.	Ensley, Ala.	1911	1	74	76

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Wood-Preserving Plants in U. S.—(Concluded)

Managing Company	Headquarters	Location of Plant	Year Built	Retorts. No.	Diam. In.	Length Ft.
tsburgh Wood Preserving Co.	Pittsburgh, Pa.	Broadford Jct., Pa.	1911	1	84	90
get Sound Wd. Pres. Co.	Lowell, Wash.	Lowell, Wash.	1895	1	84	117
				1	72	83
				1	72	52
public Creosoting Co.	Indianapolis, Ind.	Mobile, Ala.	1906	2	74	130
" " "	" "	Indianapolis, Ind.	1903	1	74	130
" " "	" "	Seattle, Wash.	1916	1	74	130
" " "	Minneapolis Minn.	Minneapolis, Minn.	1905	2	74	130
Helens Creosoting Co.	Portland, Oregon	St. Helens, Oregon	1912	4	84	136
Paul & Tacoma Lbr. Co.	Tacoma, Wash.	Tacoma, Wash.	1912	1	84	130
reveport Creosoting Co.	Louisville, Ky.	Shreveport, La.	1910	2	84	134
uthern Creosoting Co.	Slidell, La.	Slidell, La.	1879	1	84	150
			1902	2	72	100
uthern Pacific Co.	San Francisco, Cal.	Latham, Oregon	1893	2	72	117
" " "	" " "	West Oakland, Cal.	1887	1	72	108
				1	72	138
" " "	" " "	Los Angeles, Cal.	1907	2	72	112
uthern Paving & Const. Co.	Chattanooga, Tenn.	Pensacola, Fla.	1912	1	72	90
uthern Wood Pres. Co.	Atlanta, Ga.	Atlanta, Ga.	1908	1	72	100
P. L. A. & S. L. R. R. Co.	Los Angeles, Cal.	San Pedro, Cal.	1908	2	72	117
nn. C. I. & R. R. Co.	Birmingham, Ala.	McAdory, Ala.	1909	1	72	65
xas & N. O. R. R. Co.	Houston, Tex.	Houston, Tex.	1890	5	72	112
ion Pacific R. R. Co.	Omaha, Neb.	Topeka, Kan.	1909	2	73	117
" " "	" "	Laramie, Wyo.	1903	2	73	117
S. Wood Preserving Co.	New York, N. Y.	Buell (near Norfolk), Va.	1907	2	78	150
stern Wood Pres. Co.	Spokane, Wash.	Yardley, Wash.	1912	1	84	65
ckoff Pipe & Creo. Co.	New York, N. Y.	Portsmouth, Va.	1881	4	74	102
tkins Creosoting Co.	Chicago, Ill.	Metropolis, Ill.	1913	1	74	100

CANADA.

ice, Alex. & Co.	Glasgow, Scotland	Fort Francis, Ont.	1912	1	84	76
nada Creosoting Co., Ltd.	Toronto, Ont.	Trenton, Ont.	1913	1	84	134
minion Creo. Co., Ltd.	Vancouver, B. C.	Vancouver, B. C.	1910	2	90	100
minion Tar & Chem. Co.	Sydney, N. S.	Sydney, N. S.	1911	1	78	85
" " " "	" "	Transcona (nr. Winnipeg),	1912	1	78	84
				3	78	135

MEXICO.

Have no data regarding treating plants in Mexico. The Mexican Central Railroad built a plant at as Calientas, Mex., in 1901 to treat railroad ties with chloride of zinc. About the year 1907 the Madero built a 2-retort plant at Madera, Chihuahua, Mex., to treat railroad ties with chloride of zinc.

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WOOD-PRESERVING PLANTS IN U. S., CANADA AND MEXICO, JAN. 1, 1916.

NON-PRESSURE PROCESSES.

UNITED STATES.

Managing Company	Headquarters	Location of Plant	Year Built	Tanks or Boilers	
				No.	Size.
Allen, Otis & Son Co.	Lowell, Mass.	Lowell, Mass.	1848	2	4x 8x
" " " " "	" "	Portsmouth, N. H.	1875	4	4x 8x
Anaconda Copper Mg. Co.	Butte, Mont.	Butte, Mont.	1909	1	10x10x
Barnes-Lindsey Mfg. Co.	Portland, Oregon	Portland, Oregon	....	.	.....
Baxter & Jordan	Los Angeles, Cal.	Los Angeles, Cal.	1911	.	.....
Carbolineum Treating & Pav. Co.	Spokane, Wash.	Spokane, Wash.	1910	1	3x 4x
Carbolineum Wd. Pres. Co.	Portland, Oregon.	Portland, Oregon	1910	4	3x 4x
Del. Lack. & West. R. R. Co.	Scranton, Pa.	Nanticoke, Pa.	1907	1	6 dia. x
Homestake Mining Co.	Lead, S. D.	Lead, S. D.	1908	1	4 dia. x
Milwaukee Ry. & Light Co.	Milwaukee, Wis.	Milwaukee, Wis.	1910	.	.....
Naugle Pole & Tie Co.	Chicago, Ill.	Chicago, Ill.	1912	2	5x 5x
Page & Hill Co.	Minneapolis, Minn.	Minneapolis, Minn.	1911	4	6 dia. x
Pacific Light & Power Co.	Los Angeles, Cal.	Los Angeles, Cal.	1912	.	.....
P. & R. Coal & Iron Co.	Pottsville, Pa.	New Philadelphia, Pa.	1908	1	6 dia. x
Public Service Ry.	Newark, N. J.	Newark, N. J.	1909	1	10x3[illegible]
Puget Sound Wd. P. Co.	Lowell, Wash.	Lowell, Wash.	1895	1	3x10x
Reeves Co., The	New Orleans, La.	New Orleans, La.	1915	1	3x 3x
			1910	1	4x [illegible]
Republic Creosoting Co.	Mobile, Ala.	Mobile, Ala.	1912	1	3x10x
San Joaquin L. & P. Co.	Fresno, Cal.	Fresno, Cal.	1910	2	7x 9x
" " " "	" "	San Miguel, Cal.	1910	1	7x 9x
St. Paul & Tacoma Lbr. Co.	Tacoma, Wash.	Tacoma, Wash.	1915	4	7x10x
Southern Pacific Co.	San Francisco, Cal.	West Oakland, Cal.	1911	1	4x 6x
U. S. Govt. Wood Pres. Plant	Keokuk, Iowa	Keokuk, Iowa	1908	1	4x 3x
" " " " "	Milan, Ill.	Milan, Ill.	1908	1	4x 3x
" " " " "	Stillwater, Minn.	Stillwater, Minn.	1908	1	4x 3x
" " " " "	Fountain City, Wis.	Fountain City, Wis.	1908	1	4x 3x

CANADA.

Lindsley Bros.	Spokane, Wash.	Naskup, B. C.	1910	1	6 dia. x

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U. S. PATENTS ON WOOD PRESERVATION.*

Jan. 1, 1880 to Mar. 31, 1916.

Compiled by D. D. Berolzheimer,

Year	Number	Patentee	Invention
1880	235070	C. B. Carter	Process of treating wood, etc.
1881	241407	D. F. Noyes	Wood-drying apparatus.
	241686	H. W. Mattick	Composition for filling the pores of wood.
	246889	C. H. Kuhn	Composition for filling the pores of wood.
	248029	F. Donnet	Composition for filling the pores of wood.
	248334	H. W. Mattick	Composition for filling the pores of wood.
1882	258050	J. F. Jr. & J. P. Gloger	Wood composition for staining.
	259488	M. B. Church	Coating and painting exterior surfaces.
1883	284653	L. D. Mott, Jr.	Compound for preserving wood and metal.
1884	293721	W. H. Dolman	Fireproof timber.
	297568	S. Cabot, Jr.	Composition for staining and preserving wood.
	303296	J. A. Laemle	Process of and machine for coating surfaces.
	305174	L. Gimenez & J. Trigoyen	Composition for rendering wood, etc., incombustible.
	308701	L. Reed	Wood-steaming apparatus.
	310880	E. Z. Collings & C. F. Pike	Wood-preserving apparatus.
1885	317730	E. Z. Collings & C. F. Pike	Preserving wood.
	319100	F. Konrad	Composition for fireproofing.
	328016	D. H. Dickenson	Apparatus for preserving by vacuum and pressure.
1886	349172	R. E. Nichols	Preserving and waterproofing composition.
	352945	T. P. Boscher	Compound for coating wood, cordage, etc.
1888	377081	J. F. Martin	Compound for coating iron, wood, canvas, etc.
	379145	J. A. R. Wyman	Wood-drying kiln.
	380593	P. L. Quarante & E. d'Escalonne	Composition for preparing wood, etc.
	388102	A. & E. L. Wyckoff	Wood-drying kiln.
	388810	C. W. Beesly	Composition for preserving.
	393714	R. McKenny	Preserving compound.
1889	403449	H. Stokes	Wood-preserving composition.
	405908	J. W. Putnam	Wood-preserving compound.
	414246	G. Phillips	Coating for wooden structures.
	414248	G. Phillips	Preserving wood.
	414250	G. Phillips	Pile or timber.
	414251	G. Phillips	Pile or timber.
1890	425412	I. T. Dyer	Composition for coating iron and wood.
	435911	O. Williams	Preserving compound.
	437731	A. Stevens	Wood-drying apparatus.
	443238	W. A. Horrall	Treating wood and fiber.
1891	450296	J. J. Lynch & J F. Crowley	Wood filler.
	460861	J. M. & T. J. Gillihan	Preserving compound.
1893	11309	(Reissue) C. Howard	Vulcanizing and drying wood.
	497471	W. A. Gayle	Compound for preserving wood, etc.
	501235	B. R. Seifert	Creosote compound.
1894	516730	W. G. Curtis & J. D. Isaacs	Timber-preserving apparatus.
	518354	A. A. Polhamus	Method of and apparatus for preserving piles.
	520565	C. Howard	Vulcanizing and drying wood.
	520819	E. M. Caffall	Preserving articles or structures.
	529834	A. D. Polsgrove	Wood-preserving compound.

*These patents supplement the list published in the Eleventh Annual Proceedings, pages 482-500.

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U. S. Patents on Wood Preservation—(Continued).

Year	Number	Patentee	Invention
1895	542247	H. Gallinowsky	Wood preservative.
	545182	D. B. Tilley	Wood stain.
	552418	T. J. Childerson	Preservative paint.
1896	570746	W. G. Curtis & J. D. Isaacs	Car and retort for wood-preserving plants.
1898	601767	M. Arnn	Composition for coloring and preserving wood.
	602519	C. E. Postlethwaite	Wood-cleaning compound.
	605060	E. Klein	Composition for impregnating wood and fiber.
	608780	G. F. Lebioda	Wood-drying and hardening apparatus.
	611208	V. D. & H. R. Rood	Machine for applying compounds for protecting piling, timbers, etc.
1899	625042	G. F. Lebioda	Wood-hardening apparatus.
	626435	E. May	Preservative compound.
	629427	G. D. Coleman	Antifouling coating for wood.
1900	651529	S. E. Haskin	Wood-treating apparatus.
	658271	E. A. Meyer	Wood-filling compound.
	660756	G. F. Lebioda	Preserving wood.
1901	667832	C. Ischure	Wood-preserving compound.
1902	704886	E. Larsen	Apparatus for drying and distilling wood, sawdust, peat, etc., and for treating other substances.
	715362	H. Etheridge	Preserving wood or iron poles and timbers.
1903	726029	A. Classen	Treating comminuted wood, etc.
	734485	E. Wilding & A. H. Scott	Wood cleaning and preserving machine.
	736838	H. W. Gander	Wood preservative.
	748033	W. Angus	Wood-impregnating device.
1904	749004	K. Wadamori	Treating wood.
	754782	M. Lichtenberger	Preparing wood and the product thereof.
	763482	A. Gray	Drying timber.
	764872	J. H. Stewart	Treating wood and its product.
	771984	C. H. Humphrey	Wood filling and cleaning composition.
	774500	A. H. Stillwagon	Coating composition.
	777794	H. J. Livingston	Composition.
1905	782252	S. D. Kudysch	Wood filler.
	793431	F. Fleischer	Device for preventing splitting of timber.
	802754	W. A. Hall	Apparatus for treating wood pulp.
	802755	W. A. Hall	Treating wood pulp.
	802882	J. W. Piver	Treating wood to extract turpentine and rosin therefrom.
	803531	G. Groendal	Channel furnace for treating wood.
	803603	G. Kron	Producing liquid-tight joints for impregnating wood.
	804132	W. C. Jones, Stratford, Byrnes & Nixon	Saturating wood.
	805174	E. B. Weed	Apparatus for treating resinous wood.
	805214	C. B. Lowry & R. Bernhard	Wood impregnating apparatus.
	806540	A. C. Hager	Preserving compound and making the same.
1906	820442	W. T. Scheele	Apparatus for preserving by liquid air.
	824901	R. Berendes	Creosote compound.
	836316	L. H. Gaskill	Compound for preserving wood.
1907	12707	(Reissue) M. Rueping	Impregnated wood, etc.
	848690	H. Romuender	Wood covering or facing.
	860079	J. Binks	Method of and apparatus for treating wood with paraffin.
	871392	C. Ellis	Preserved wood and making same.
1908	883507	P. F. Apfel & R. L. Earnest	Protecting piles against worms, etc.
	891987	W. A. Hall	Vulcanizing and coloring wood.
	893010	L. E. Odell	Liquid-coating compound.
	894061	J. Ruetgers	Impregnating wood.
	896335	H. Stokes	Wood-preserving compound.
1909	912013	D. C. Meehan	Protecting wood
	913593	B. F. Watkins	Apparatus for impregnation of wood.

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U. S. Patents on Wood Preservation—(Continued).

Year	Number	Patentee	Invention
	917265	B. Diamond	Preserving wood.
	922026	F. Y. Nishimura	Treating wood.
	924770	W. A. Hall	Treating low-priced wood.
	925292	J. Chateau & J. Merklen	Impregnating wood.
	933435	W. A. Hall	Coloring wood.
	933436	W. A. Hall	Coloring wood.
	933437	W. A. Hall	Coloring wood.
	936070	K. H. Wolman	Wood-impregnating liquor.
	937008	J. M. Nelson, Jr.	Preserving wood.
	937802	W. A. G. von Heiderstam & K. L. F. Friedemann	Preserving wood.
	939014	W. A. Hall	Coloring wood.
	939015	W. A. Hall	Coloring wood.
	939016	W. A. Hall	Coloring wood.
	939273	J. W. Lafer	Composition for treating "blight wood."
	942106	W. H. Pocoley	Treatment of coniferous woods.
1910	945693	Chateau & Merklen	Preserving wood.
	947420	F. Pope	Bath for extracting products from wood.
	948355	C. P. Tatro & G. Delius	Protecting wood in salt water.
	949671	L. H. Baekeland	Method of indurating fibrous and cellular material.
	952245	L. S. Gardner	Wood coloring.
	952887	P. F. Dundon	Wood-preserving apparatus.
	952888	P. F. Dundon	Wood creosoting.
	955762	W. B. Chisholm	Preserving wood.
	956382	J. T. Logan	Preserving wooden poles.
	959505	J. Gerlache	Preserving wood.
	959599	F. Pope	Extracting products from wood.
	961903	P. J. Shaffer	Composition of matter for cleaning and shining wood.
	964017	W. A. Hall	Transforming wood.
	965154	W. B. Chisholm	Impregnating wood.
	966983	Anduan & Bourrelly	Wood bending and hardening machine.
	967952	T. Moran	Pile or timber covering.
	971194	F. Hasselmann	Wood-preserving solution.
	971799	J. W. Stevenson	Preserving compound.
	974962	Hartman & Schwerdtner	Preserving wood.
	976715	S. Willner	Timber-impregnating apparatus.
	979901	F. J. Taylor	Treating wood.
1911	981383	C. H. Comstock	Machine for treating interior woodwork, and flooring.
	982631	F. Pope	Apparatus for extracting products from wood.
	985392	J. B. Card & Frank McArdle	Apparatus for treating wooden blocks.
	986751	J. C. Paty	Treating timber with preservative fluid.
	987888	K. Koenman	Treating wood.
	990246	J. L. Fetterman	Seasoning wood.
	991200	J. Dehnst	Preserving wood.
	991434	C. Ellis	Wood-preserving composition.
	992114	W. E. Curry	Apparatus for bending, preparing and softening wood.
	992256	I. L. Roberts	Process of making acid or alkali-resisting materials.
	992918	C. S. Smith	Impregnating wood.
	995796	B. R. & M. J. Lyster	Wood-reducing apparatus.
	997557	J. W. Johnson	Wood-extracting device.
	999013	J. Dehnst	Process of preparing wood-impregnating liquids.
	1001657	J. M. Long	Composition for preserving wood, etc.
	1004168	C. Howard	Vulcanizing wood.
	1004252	J. T. Hall	Preservative preparing apparatus.
	1006076	K. L. F. Friedemann	Preserving wood.
	1006077	K. L. F. Friedemann	Preserving wood.
	1006713	A. F. Barry	Preserving hardwood.
	1007513	A. U. Alcock	Electric process for drying timber.
	1007877	K. Koenman	Wood-Preserving.

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U. S. Patents on Wood Preservation—(Continued).

Year	Number	Patentee	Invention
	1008864	M. Rueping	Impregnation of wood, etc.
	1010122	J. A. de Cew	Preserved wood and making same.
	1012207	Kolossvary, Haltenberger & Berdenich	Impregnating timber.
	1012283	Schmidt, Wislicenus & Kleinstueck	Wood coloring.
1912	1015862	W. J. Watson	Preserving wood.
	1016111	E. Sucher.	Preserving and hardening wood.
	1016024	E. Marmetschke	Preserving wood.
	1017636	C. Ellis	Wood-Preserving.
	1021676	C. Howard	Vulcanized wood.
	1020643	C. Ellis	Preserved wood and process of making same.
	1020857	A. J. Tucker	Waterproofing and preserving compound.
	1022064	C. H. Curtis	Preserving wood.
	1023745	R. A. Marr	Preserving cut timber and product thereof.
	1023784	R. A. Marr	Preserved wood and making same.
	1024864	J. Polifka & B. Hacker	Impregnation of wood.
	1025628	J. W. Illingworth	Treating wood.
	1028201	C. Ellis	Preserving wood.
	1030909	G. A. Mesturino	Composition of matter for fireproofing and other purposes.
	1031505	M. P. Andrews	Blocks of wood fiber.
	1034652	F. Seidenschnur	Preserving wood by phenolate solution.
	1034680	S. Biterman	Artificial timber.
	1035777	A. R. Bullock	Impregnating substances.
	1035789	C. T. Henning	Compounding a preservative composition.
	1036706	E. L. Powell	Wood-preserving compound.
	1037831	H. M. Newton	Preserved wood.
	1037832	H. M. Newton	Preserved wood.
	1038423	W. W. Norman	Wood-impregnating apparatus.
	1039824	G. Schumacher	Protecting wood in salt water.
	1041681	F. Seidenschnur & J. Dehnst	Composition of matter for preserving and fireproofing wood.
	1041682	F. Seidenschnur & J. Dehnst	Composition of matter for preserving and fireproofing wood.
	1042182	E. Wilhelm	Coloring wood.
	1042564	N. Kolar	Preserving wooden articles buried in the earth.
	1043582	C. J. Faller	Preserving and coloring wood.
	1044201	J. C. Lincoln	Preserving.
	1045110	C. Ellis	Preserved wood and making same.
	1045643	C. Ellis	Preserved wood and making same.
	1047404	W. F. Goltra	Preserving wood.
	1047405	W. F. Goltra	Installation for treating railway ties.
	1047406	W. F. Goltra	Drying apparatus for railway ties.
	1048102	T. H. Sampson	Treating red gum and other like woods.
1913	1051596	J. W. Illingworth	Treatment of wood.
	1054756	C. Ellis	Preserving wood and product thereof.
	1057076	H. Monseur	Process of preserving organic materials.
	1057211	L. H. Baekeland	Impregnating wood and product thereof.
	1057319	L. H. Baekeland	Impregnated wood and preparing same.
	1059879	F. M. Kenedy	Preventing molding in shaped timber.
	1062184	F. A. Palen	Wood-treating apparatus.
	1062286	H. J. Livingston	Preserving wood from decay.
	1062550	J. Peschauer	Wood-treating apparatus.
	1063964	C. E. Fuller	Process of treating paving blocks.
	1063965	C. E. Fuller	Apparatus for treating paving blocks.
	1074588	T. Dawson	Seasoning machine.
	1075552	J. A. de Cew	Wood product.
	1076322	W. Schoeller & W. Schrauth	Preserving wood.
	1076553	L. Dautreppe	Impregnating wood.
	1076762	W. A. Hall	Art of fireproofing wood.
	1077252	L. S. Bache	Process of treating and coloring wood and such products.
	1080966	W. A. Hall	Fireproofing composition.
	1081158	G. B. Shipley	Apparatus for preserving wood.

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U. S. Patents on Wood Preservation—(Continued).

Year	Number	Patentee	Invention
	1082658	E. E. Somermeier	Preserving wood.
1914	1087144	W. Schoeller & W. Schrauth	Preserving preparation.
	1087145	W. Schoeller & W. Schrauth	Preservative coating composition.
	1093230	W. E. Williams	Method of preserving railway tie timber against injury from splitting and decay.
	1104488	W. J. Frame & H. L. Galloway	Apparatus for impregnating porous material.
	1105055	C. M. Abbott	Method of treating bundles of shingles.
	1107623	C. F. Leatherbee	Wood-treating machine.
	1109334	H. C. Holthoff	Timber-treating apparatus.
	1109653	J. B. Card & F. McArdle	Apparatus for treatment of wood blocks.
	1111286	J. W. Aylesworth	Condensation product.
	1111302	J. C. Fitzsimmons	Wood preservative.
	1113781	J. W. Grimes	Fireproof and wood-preserving paint.
	1113782	J. W. Grimes	Fireproof and wood-preserving paint.
	1116349	W. C. Zeller	Fireproofing composition.
	1121643	R. A. Marr	Preserved wood and method of making same.
	1121644	R. A. Marr	Buoyant articles and process of making same.
	1121645	R. A. Marr	Process of treating wood for buoyant articles and product thereof.
	1121646	R. A. Marr	Preserved wood and method of making same.
	1122407	F. Moll	Apparatus for impregnating wood.
1915	1129430	R. I. Smith	Process of preserving wood.
	1131427	T. H. Sampson	Apparatus for the treatment of red gum and other woods.
	1133499	E. Pollacsek	Binding and impregnating materials from waste sulfite liquor.
	1134044	A. P. Godell	Process of preserving wood.
	1136723	A Schmidt	Unexplosive preparation.
	1136724	A. Schmidt	Non-explosive preparation.
	1140127	J. A. de Cew	Wood preservative.
	1142610	W. W. Norman	Process of treating wood.
	1142611	W. W. Norman	Apparatus for treating wood.
	1143714	O. W. Knight	Process for treating sulfite waste liquor and product thereof.
	1144669	G. B. Shipley	Apparatus for treating wood with liquid preservatives.
	1146212	J. P. Sullivan	Compound for treating timber.
	1146501	H. G. Jennison	Impregnating piles.
	1147066	J. Adler	Process for coating composition and wooden articles.
	1147635	H. S. Loud	Method of treating materials with liquid preservative.
	1148013	H. A. Gardner	Method of rendering wood fire-resisting.
	13952	(Reissue) R. A. Marr	Impregnated wood and producing the same.
	1150499	J. W. Carr	Wood-preserving compound.
	1151039	E. L. Powell	Preserved timber and method of making same.
	1151204	H. S. Loud	Method of preserving wood.
	1151205	H. S. Loud	Method of treating porous bodies with liquid preservative.
	1154447	O. S. Sleeper	Impregnating apparatus.
	1155130	S. R. Church	Weather and Flame resistant shingle and method of making same.
	1158404	J. W. Illingworth	Process of preserving and improving lumber.
	1162453	S. R. Church	Weather & flame resistant composition for fibrous material, etc.
	1163270	G. B. Shipley	Impregnating timber.
	1163271	G. B. Shipley	Fireproofing timber.
	1164938	J. H. Grow	Timber treating apparatus.

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U. S. Patents on Wood Preservation—(Concluded).

Year	Number	Patentee	Invention
	1165355	D. H. Bibb	Waterproofed wood and process of producing same.
	1165753	W. D. Clark	Preservative treatment of timber.
1916	1166819	A. P. Derby and J. H. Dargie	Method of treating wood and other porous materials.
	1167417	C. F. Leatherbee	Wood-treating machine.
	1167492	O. P. M. Goss	Art of impregnating timber and other porous material with a preservative.
	1168944	R. Lamb	Impregnating wood.
	1169289	C. H. Shattuck	Process of treating woods.
	1169349	J. Pinal e Icaza	Method of treating wood and product thereof.
	1176284	C. E. Fuller	Method of treating porous blocks.
	1176345	G. A. Cook	Process of preparing creosote oil.
	1177493	Z. G. Crittenden	Process of treating lumber.

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By Dr. F. Moll.

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12. 1863. and 1868. Bate and Westwood: British Sessile-eyed Crustacea. Vol. 1, Amphipoda; Vol. 2, Isopoda.
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Rwy. Review	Chicago, Ill.	Weekly
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Roadmasters & M. of W. Assoc. of Am.	Sterling, Ill.	Monthly
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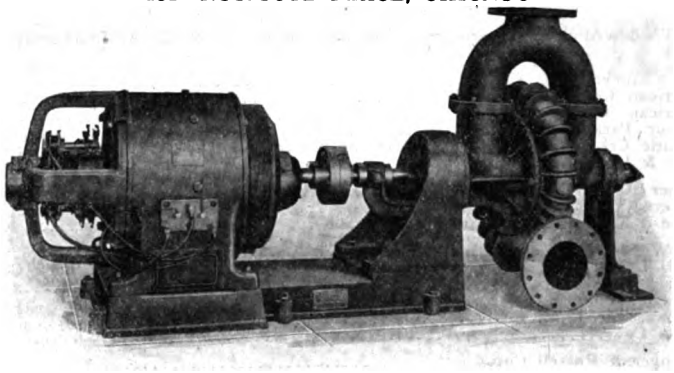

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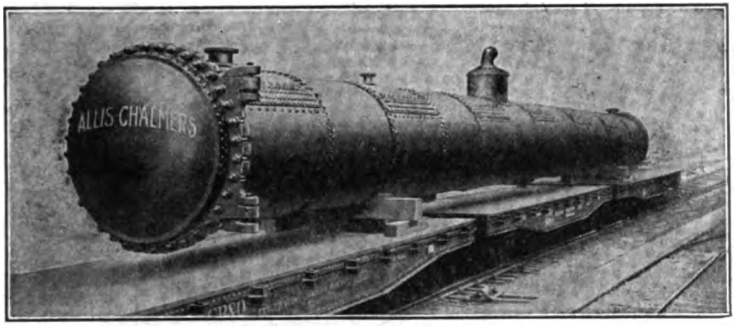

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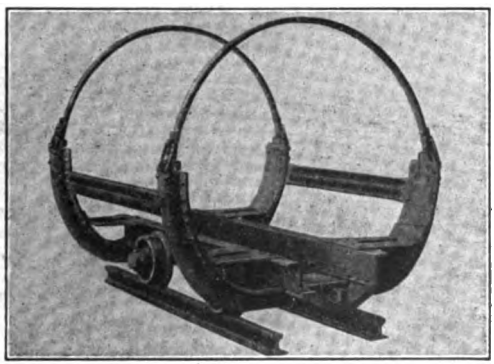

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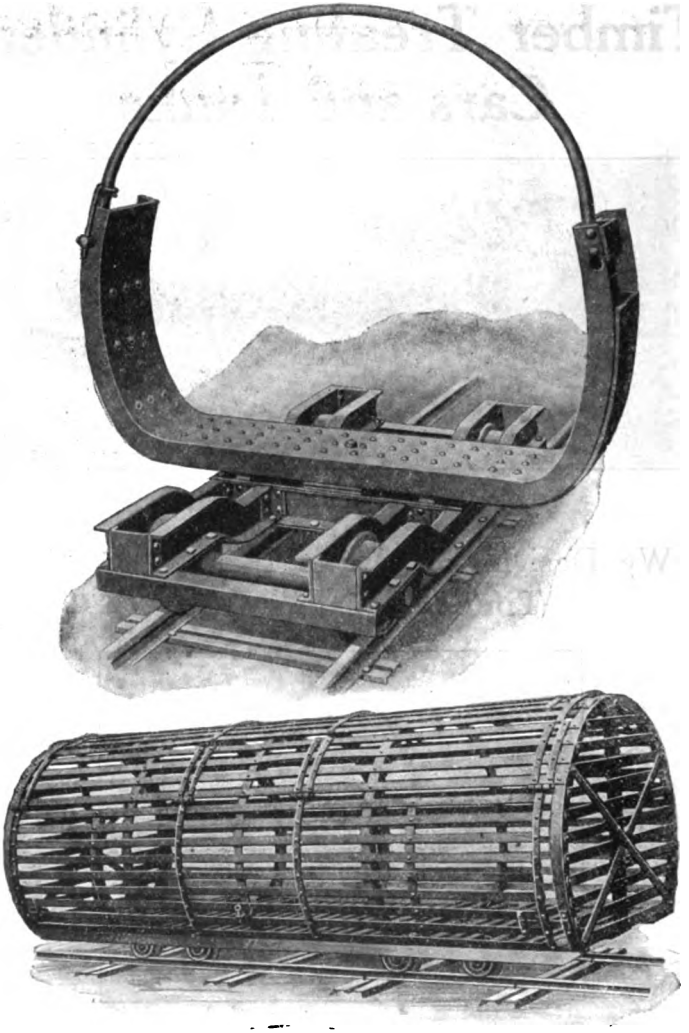

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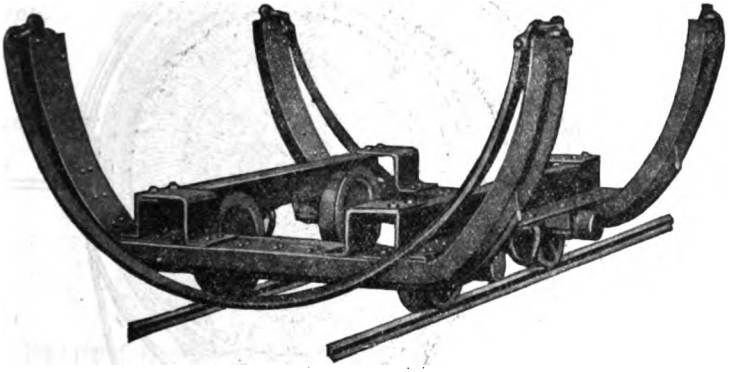

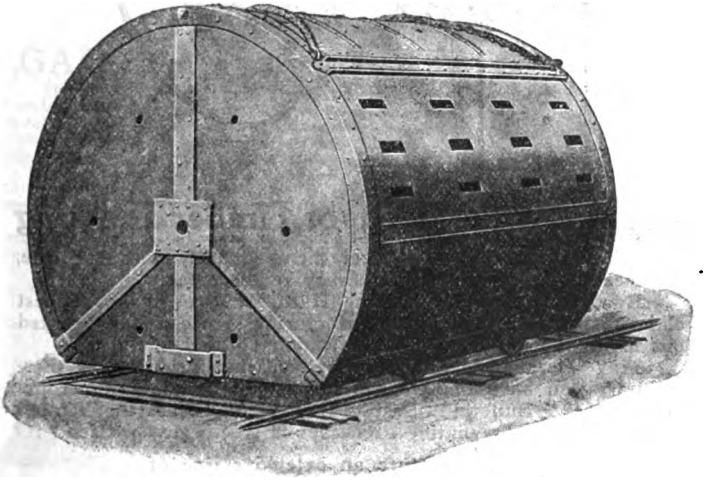

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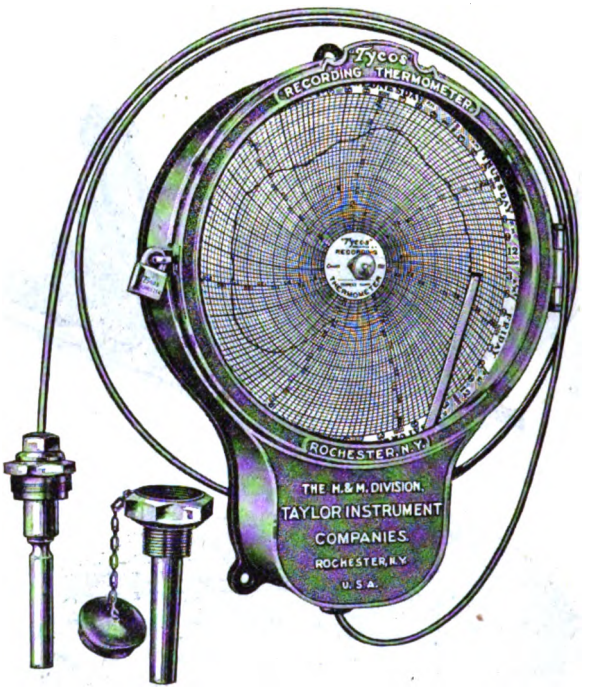

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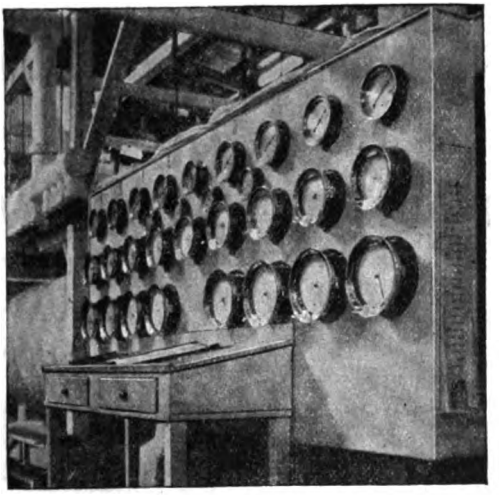

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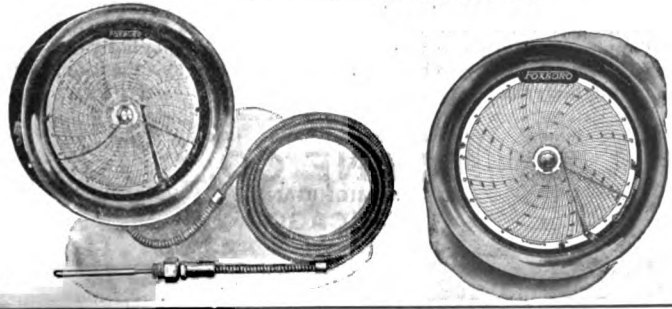

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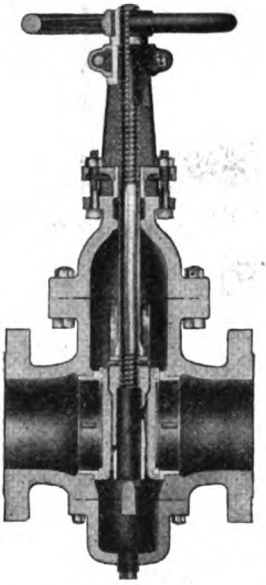

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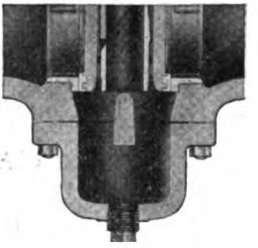

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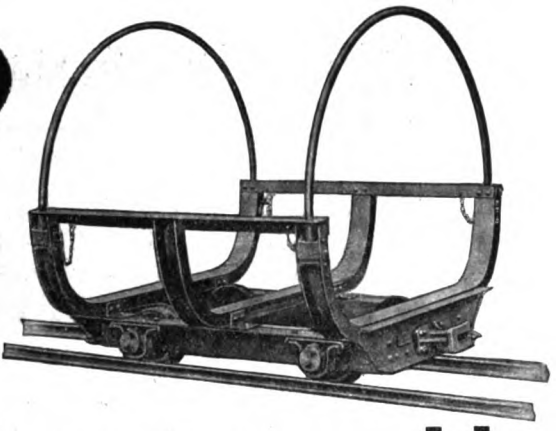

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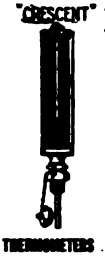

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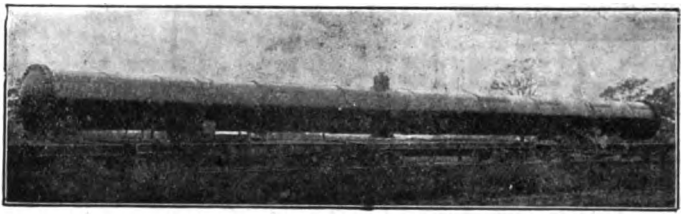

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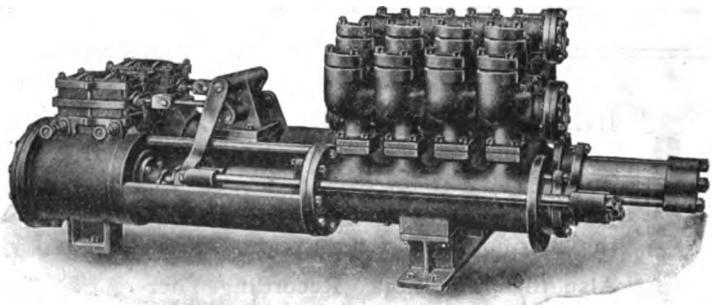

We make a specialty of equipping timber preserving plants with pumping machinery, including condensers, tank and pressure pumps for creosote oil, vacuum pumps both wet and dry, boiler feed pumps, air compressors, meters for measuring creosote oil, tannic acid, etc.

The Blake & Knowles Steam Pump Works

115 Broadway, New York City **Works: East Cambridge, Mass.**

Branch Offices in all Principal Cities.

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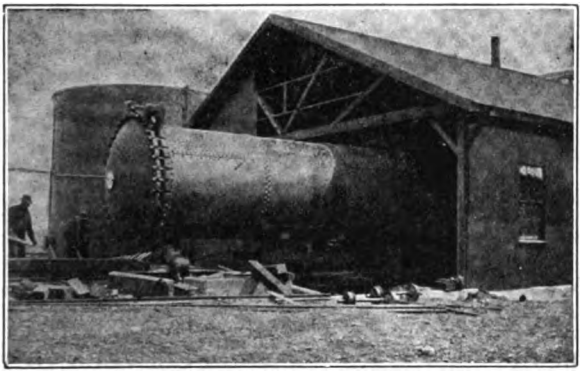

Installing Manitowoc Retort

Retorts and Tanks

HEAVY PLATE CONSTRUCTION

MANITOWOC ENGINEERING WORKS,

Manitowoc, Wisconsin.

F. J. Lewis Mfg. Co.

—DISTILLERS—

Coal Tar Products

Creosote Oil
Paving Pitch
Coal-Tar Chemicals, Etc.

Chicago, Ill. Moline, Ill.

Birmingham, Ala. New Orleans, La.

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The Barrett Company

NEW YORK
PHILADELPHIA
ST. LOUIS
CINCINNATI
NEW ORLEANS
BIRMINGHAM
NASHVILLE
LOUISVILLE
PEORIA

CHICAGO
BOSTON
CLEVELAND
PITTSBURGH
DETROIT
KANSAS CITY
MINNEAPOLIS
SEATTLE
SALT LAKE CITY

Coal Tar Products

Largest Producers of

CREOSOTE OIL

in the United States

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AMERICAN TAR PRODUCTS COMPANY

Roofing, Paving Pitch

CREOSOTE OIL

PLANTS:

St. LOUIS, YOUNGSTOWN, WOODWARD,
MILWAUKEE, MONTREAL
STEUBENVILLE

GENERAL OFFICE:

CHICAGO

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REPUBLIC CREOSOTING COMPANY

PLANTS,

Indianapolis - Mobile - Minneapolis - Seattle

MANUFACTURERS OF

Reilly Improved Creosote Oil

Maintenance of Way Oils

AND

Special Creosote Oils

The above oils furnished promptly in any quantity

To obtain permanent and stable preservation of timbers the Creosote Oil used must be of a permanent and stable quality.

The Reilly Improved Creosote Oil is the most stable and highest grade of Creosote Oil known. It is greatly superior to the German Creosote Oils, and the margin of superiority between it and the German Creosote Oils is greater than that between the German Creosote Oils and the ordinary Creosote Oils. (See comparative analysis.)

Railroad Cross-Ties, Telegraph Poles, Cross-Arms, Piling, Bridge and Structural Timbers, Street Paving Blocks, Bridge and Interior Floor Blocks treated with Reilly Improved Creosote Oil are preserved to the full limit of their mechanical life.

Republic Creosoting Company

PRINCIPAL OFFICES

INDIANAPOLIS, INDIANA

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Chloride of Zinc

Fused and Solution

For Wood Preserving

AND OTHER PURPOSES

The quality of our Chloride is second to none and we carry large stocks at Cleveland and Chicago :: ::

WE SOLICIT INQUIRIES

The Grasselli Chemical Co.

Main Office

CLEVELAND, OHIO.

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The Rueping Process

—OF—

PRESERVING TIMBER

—IS—

THE ONLY RELIABLE SAVING PROCESS

It is now used by the following systems:

UNITED STATES:

Railroads:

Atchison, Topeka & Santa Fe Ry. System
Atlantic Coast Line R. R. Co.
Boston Elevated Railway Co.
Central of Georgia Ry. Co.
Charlotte Harbor & Northern Ry. Co.
Chicago, Rock Island & Pacific Ry.
El Paso & Southwestern System
Illinois Central R. R. Co.
Missouri, Kansas & Texas Ry. System
Pennsylvania Railroad Co.
Philadelphia & Reading Ry. Co.
Pittsburgh & Lake Erie Railroad

Commercial Plants:

American Creosote Works, Inc.
Ayer & Lord Tie Co.
Compressed Wood Preserving Co.
Continental Tie & Lumber Co.
Gulfport Creosoting Co.
International Creosoting & Construction Co.
Jennison-Wright Co.
Kettle River Company
Michigan Wood Preserving Co.
National Lumber & Creosoting Co.
Ohio Wood Preserving Co.
Pacific Creosoting Co.
Pittsburgh Wood Preserving Co.
St. Helens Creosoting Co.
St. Paul & Tacoma Lumber Co.
Southern Creosoting Co., Ltd.
Southern Wood Preserving Co.

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German State Railways	Germany
Imperial Post and Telegraph Lines	Germany
United Federal Railways	Switzerland
Italian State Railways	Italy
French State Railways Co	France
Portuguese State Railway	Portugal
State Railway of Denmark	Denmark
State Railway of Norway	Norway
Royal Post & Telegraph Lines	Norway
State Railway of Sweden	Sweden
State Railway of Finland	Finland
South Railway of Russia	Russia
G. Lowenfeld Impregnating Works	Austria
State Railway of Roumania	Roumania
Post and Telegraph Lines	England
Burt, Boulton & Haywood	England
Richard Wade Sons & Co	England
Armstrong, Addison & Co	England
English Bros., Ltd	England
Corry & Co	Ireland

For particulars on the **Rueping Process** apply to

Lembcke, von Bernuth Co., Inc., 171 Madison Avenue, New York

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We have a modern, two-cylinder plant on the Passaic River at *Newark, N. J.*

We can make Prompt Delivery of

Creosoted Ties
Wood Paving Blocks
Lumber and Piling

We invite correspondence concerning the value of treated material for permanent construction.

American Creosoting Company

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WOOD PRESERVERS SINCE 1878.

EPPINGER AND RUSSELL CO.

MAIN OFFICE—165 BROADWAY, NEW YORK.

CREOSOTED

LUMBER PILING TIES

Export Orders Solicited—Water or Rail Shipment.

ALSO DEALERS IN

YELLOW PINE LUMBER AND TIES.

WORKS AT

JACKSONVILLE, FLA. **LONG ISLAND CITY, N. Y.**

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Indiana Tie Company

Evansville, - - Indiana

Railroad Ties and Timber,

Treated by Chloride of Zinc,

Zinc-Creosote and Creosote Process.

Manufacturers of White Oak,

Chestnut and Treatment Ties.

Timber Preserving Works,
Joppa, Illinois,
Evansville, Indiana.

General Offices,
Citizens National Bank Bldg.
Evansville,
Indiana.

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JOYCE-WATKINS CO.

RAILWAY TIES

TREATED BY

THE CREOSOTE,
CHLORIDE OF ZINC AND
ZINC-CREOSOTE PROCESSES

PLANT LOCATED AT METROPOLIS, ILL

332 SOUTH MICHIGAN AVENUE

CHICAGO

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Pittsburgh Wood Preserving Company
Ohio Wood Preserving Company
Michigan Wood Preserving Company

GRANT B. SHIPLEY, President

Ties, Poles, Piling, Bridge Timbers,
Cross Arms, Trunking and
PAVING BLOCKS

We manufacture a Special Block which will not bleed and is desirable for factory floors, warehouses, freight stations, station platforms, approaches where the ordinary block is unsuitable.

WE ARE EQUIPPED TO USE CREOSOTE AND ZINC CHLORIDE IN ACCORDANCE WITH STANDARD SPECIFICATIONS AND WE GUARANTEE OUR WORK.

GENERAL OFFICE:

2006 Commonwealth Bldg., Pittsburgh, Pa.

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BROADFORD JCT., Near Connellsville, Pa.
ORRVILLE, OHIO REED CITY, MICHIGAN

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AYER & LORD

INTERIOR

Creosoted Wood Block Floor

Increases the general efficiency of your plant and promotes satisfaction amongst your workmen. Let us submit facts and figures to substantiate these claims.

AYER & LORD TIE CO.

RAILWAY EXCHANGE :: :: CHICAGO

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Pacific Creosoting Company

LARGEST CREOSOTING PLANT IN THE WEST

Creosoted Douglas Fir

PILING	MINE TIMBERS	CROSS ARMS
LUMBER	BRIDGE TIMBERS	PAVING BLOCKS
RAILROAD TIES	CONDUIT	STAVE PIPE

EQUIPPED FOR RAIL OR CARGO SHIPMENTS

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Northern Life Bldg., Seattle, Wash.

WORKS:
Eagle Harbor, Wash.

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National Lumber and Creosoting Co.

TREATED TIES
BRIDGE TIMBERS, PILING, POLES AND
PAVING BLOCKS.

Full Burnetized Creosoted Butt Poles.

Equipped for the Treatment of Timber with
Various Processes.

TREATING PLANTS:
TEXARKANA AND HOUSTON.

OFFICES:
Texarkana, Arkansas.
Houston, Tex. El Paso, Tex.
Kansas City, Mo.

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R. J. CALDER, Vice-President and Gen. Mgr.
R. L. ALLARDYCE, General Superintendent
H. A. WEST, Secretary-Treasurer
E. E. BOEHNE, Manager Sales Department

INTERNATIONAL CREOSOTING & CONSTRUCTION COMPANY

CREOSOTED

TIES
SWITCH TIES
BRIDGE TIMBERS
BARGE SHEATHING
PAVING BLOCKS
PILING
POLES
CROSS-ARMS

LUMBER

Plants Equipped for all Processes.
Shipments by Rail or Water.

We are in position to do all classes of Framing before treatment. Western Union, A. B. C. and American Lumberman Telecode

General Office, Galveston, Texas.

LOCATION OF PLANTS:
Galveston, Beaumont, Texarkana, Texas.

Combined Capacity, 100 Million Feet B. M.
Address all Communications to General Office

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WE ARE PREPARED TO FURNISH
IN ANY QUANTITY

CREOSOTED

CROSS TIES
BRIDGE TIMBERS
PILING
POLES
PAVING BLOCKS
CROSS ARMS

FOR EXPORT
OR
INTERIOR SHIPMENTS

GULFPORT
CREOSOTING COMPANY
GULFPORT MISSISSIPPI
U. S. A.

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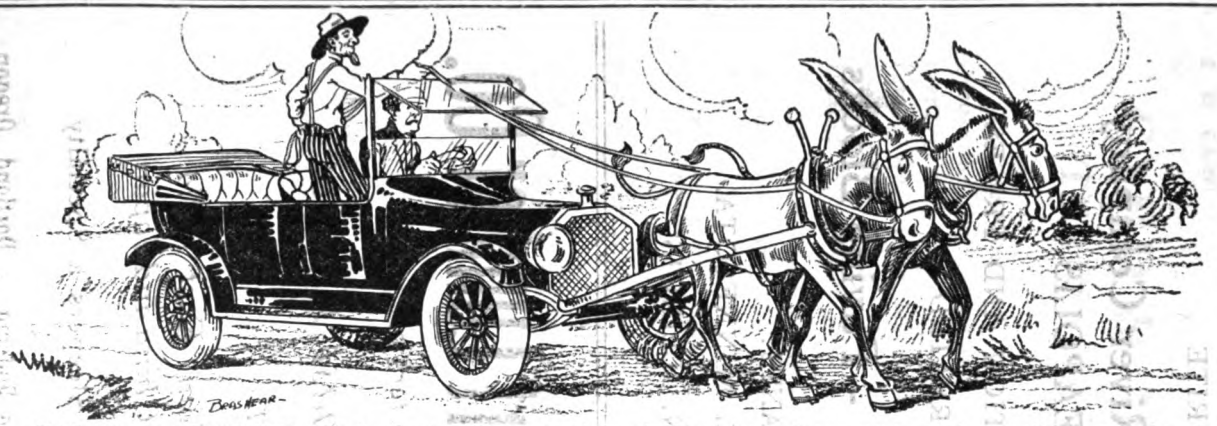

FALSE ECONOMY—This automobilist thought because kerosene and gasoline are by-products of the same oil, it would be cheaper to use kerosene. AND HE TRIED IT!
The same results are derived when you use creosote oil for the brush or open tank treatment, instead of "C-A-WOOD-PRESERVER." The U. S. Forest Products Laboratory tests show "C-A-WOOD-PRESERVER" to be the most toxic, least evaporative carbolineum or like wood preserver on the market.
Furthermore, Messrs. S. R. Church, Chief Chemist, Barrett Mfg. Co., Dr. A. L. Dean, Yale University, Dr. G. Alleman, Swarthmore College, Mr. J. W. Harris, Chief Chemist, Western Union and Bell Tel. Companies, and other authorities, testified in U. S. Customs trials, *that the more high boiling pure coal tar distillates a preserver contains, the better it will preserve wood.* Our oil contains over 90%! WHAT ADDITIONAL PROOF DO YOU REQUIRE?

C-A-WOOD-PRESERVER COMPANY, INC. - - - - St. Louis, Mo. and Branches

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WRITE

The Kettle River Company
MINNEAPOLIS

FOR INFORMATION AND PRICES
ON TREATED

Ties - Timber - Paving Blocks

PLANTS:
SANDSTONE, MINNESOTA.
MADISON, ILLINOIS

Pacific Export Lumber Co.

Exporters of

Pacific Coast Lumber

To

United Kingdom, East India,
New Zealand, China and Japan

Creosoted Railway Sleepers a Specialty

1004 Chamber of Commerce Building, - Portland, Oregon

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J. B. CARD FRANK McARDLE

CARD & McARDLE
TERRE HAUTE, IND.

Our new vertical retort installed for the Chicago Creosoting Company has proved the greatest development in the Creosoted Wood Block business. The retorts were fully described on page 297 of the Proceedings for 1914. If you are interested, write for further information.

Eighteen years' experience in designing, constructing and operating

TIMBER TREATING PLANTS

Chicago Creosoting Company
30 North La Salle St.,
CHICAGO

Railroad Ties, Paving Blocks and Timber Treated by Creosote, Chloride of Zinc and Zinc-Creosote Processes.

CREO-ZINC FLOOR BLOCKS FOR INTERIOR WORK

We Invite Correspondence

Northern Plant
Waukegan, Ill.

Southern Plant
Terre Haute, Ind.

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Scientific Creosoting

RAILROAD TIES POLES—PILES

STREET PAVING BLOCKS

STRUCTURAL TIMBERS

KREOLITE WOOD BLOCK FACTORY FLOORS

Modern Equipment. Prompt Shipment.

The Jennison-Wright Co.

300 HURON STREET TOLEDO, OHIO

General Chemical Co.,

112 West Adams Street
CHICAGO

MANUFACTURERS OF PURE

Chloride of Zinc

Specially adapted to timber preservation.

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COLMAN CREOSOTING WORKS

THE J. M. COLMAN COMPANY
627 COLMAN BUILDING
SEATTLE, WASHINGTON

Creosoted Piles
Timber and Ties

PLANT LOCATED AT:
Railroad Ave. & 27th Ave. S. W., Seattle, Wash.

INDIANA ZINC-CREOSOTING CO.

JOS. B. CARD, President

Zinc-Creosoted Railroad Ties

FENCE POSTS AND SHINGLES

CARD PROCESS

Have your ties treated with a mixture of zinc-chloride and creosote-oil, injecting any quantity of each of these standard preservatives. There is a reason. Let us tell you about it. Address, in care of plant,

TERRE HAUTE, IND.

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Atlantic Creosoting and Wood Preserving Works

NORFOLK, VIRGINIA

This thoroughly modern plant equipped with three cylinders and latest appliances for the treatment of piles and timber with Creosote Oil or other preservatives is situated immediately on Norfolk harbor, with unequalled facilities for shipping via rail or water. We solicit your inquiries, assuring our customers lowest possible prices consistent with specifications and prompt delivery.

R. D. PARROTT, General Manager - - Norfolk, Va.

Stop the Checking of Cross-Ties by Using

S, Z and CRINKLE IRONS

Write us for samples and quotations

Keystone Manufacturing Co.,

ALTOONA, PENNA.

THE ANCHOR PACKING CO.

PHILADELPHIA, PA.

We make a Specialty of Gaskets and Packing for Creosoting Work

LETTENEY

TRADE MARK Registered

WOOD PRESERVATIVE

Anthracene Oil of Highest Quality

FOR OPEN TANK AND BRUSH TREATMENT

Has a record of Highest Efficiency on Timber Work in the United States since 1867

THE NORTHEASTERN COMPANY

6 BACON STREET :: :: :: BOSTON, MASS.

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Pittsburgh Testing Laboratory

PITTSBURGH, PA.

PLANT INSPECTION

of Treated Timbers, Ties and Paving Blocks.

Inspectors located at all principal Treating Plants.

Southern Creosoting Co., Ltd.

SLIDELL, LA.

Capacity 20,000,000 Feet Annually

A thoroughly modern plant for the preservation of wood by the injection of dead oil of coal tar. Located in the heart of the yellow pine timber belt.

CREOSOTED MATERIAL

including Telephone Poles and Cross Arms, Heavy Timbers and Piling, Lumber, Paving Blocks and Ties.
We make a specialty of cross arms, and can handle large orders with the utmost promptness.

IT PAYS TO USE CREOSOTED MATERIAL

T. J. Moss Tie Company

ST. LOUIS, MO.

RAILROAD TIES CHEMICALLY TREATED

Treating Plant at Mt. Vernon, Ill.

STRAIGHT ZINC CHLORIDE, STRAIGHT CREOSOTE, ZINC-CREOSOTE BY THE CARD PROCESS.

We also handle White Oak and Chestnut Ties.

WRITE US AT ST. LOUIS.

SHILLITO & MURCHIE, INC.,

CONSULTING INSPECTORS

Inspection of Ties, Timber, Piling, Paving Block and Their Preservative Treatment.

Analysis of Creosote at Treating Plant.

Consultation on Specifications.

70-80 BROAD ST., NEW YORK.

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CREOSOTING

Southern Wood Preserving Company

Lee Street
ATLANTA, GEORGIA

Wood Paving Blocks

RAILWAY TIES
AND TIMBERS
WOOD CONDUIT
CROSS ARMS, POLES

ST. PAUL & TACOMA LUMBER CO.

CREOSOTING DEPARTMENT

Creosoted Piles, Lumber and Paving Blocks
Rail and Cargo Shipments
Creosoted Butt-Treated Telephone Poles
"12 hours hot—12 hours cold"

GEOFFREY WINSLOW, Manager :: TACOMA, WASH.

CREOSOTED

Lumber, Bridge Stringers, Railroad Ties and Piling.

Inquiries Solicited.

ST. HELENS CREOSOTING CO.

912-913 Yeon Bldg.,
PORTLAND OREGON

WOOD-PRESERVING

DEAD OIL OF COAL TAR PROCESS

Ties, Piling, Bridge and Dock Timbers, Lumber, Poles and Cross-Arms Creosoted according to specifications.

FOUR CYLINDERS 6 x 115 FEET

TREATED WOOD PAVING BLOCKS for Warehouse, Roundhouse or Shop Floors, Station Approaches and Street Paving.

THE BARBER ASPHALT PAVING CO.

Docks on Staten Island Sound Office and Works, Maurer, N. J.
Rail or Water Delivery.

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The Buyers' Guide

(See Alphabetical Index to Advertisers, Page III.)

Boring and Adzing Machines.

Greenlee Bros. & Co.

Cars—Ties, Piling, Wood Block, Etc.

Allis-Chalmers Mfg. Co.
Lakewood Engineering Co.
Orenstein-Arthur Koppel Co.

Creosote Oil.

American Tar Products Co.
Barrett Co., The
Cleveland-Cliffs Iron Co.
Lewis, The F. J. Mfg. Co.
Republic Creosoting Co.

Engineers, Chemists, Etc.

Hunt, Robert W. & Co.
Pittsburgh Testing Laboratory
Shillito & Murchie, Inc.

Exporters—Treated Timber.

Eppinger & Russell Co.
Gulfport Creosoting Co.
Pacific Creosoting Co.

Gauges, Recording.

Foxboro Co., The
Schaeffer & Budenberg Mfg. Co.
Taylor Instrument Companies

Industrial Railways.

Orenstein-Arthur Koppel Co.

Packing.

Anchor Packing Co.

Pipes and Valves.

Crane Co.

Pitch, Paving.

American Tar Products Co.
Barrett Co., The
Lewis, The F. J. Mfg. Co.

Processes.

Card, J. B. (Card.)
Lembcke, von Bernuth Co. (Rueping.)

Preservatives—(See also Creosote, Zinc Chloride, Etc.)

C-A-Wood-Preserver Co.
Northeastern Co., The (Letteney.)

Publications.

Wood-Preserving

Pumps.

Blake & Knowles Steam Pump Works.
Yeomans Brothers Co.

Pyrometers, Radiation.

Taylor Instrument Companies.

Retorts.

Allis-Chalmers Mfg. Co.
Manitowoc Engineering Works.
Power & Mining Machinery Co.

Roofing.

American Tar Products Co.
Barrett Co., The.

S, Z & Crinkle Irons.

Keystone Mfg. Co.

Tanks.

Allis-Chalmers Mfg. Co.
Graver, Wm., Tank Works.
Manitowoc Engineering Works.
Power & Mining Machinery Co.

Thermometers.

Foxboro Co., The
Schaeffer & Budenberg Mfg. Co.
Taylor Instrument Companies

Timber—Producers & Dealers.

Eppinger & Russell Co.
Indiana Tie Co.
Moss Tie Co., T. J.
St. Paul & Tacoma Lumber Co.

Treated Timber—Ties, Paving Block, Etc.

American Creosoting Co. of New York.
Atlantic Creo. & Wood Pres. Works.
Ayer & Lord Tie Co.
Barber Asphalt Paving Co.
Card & McArdle.
Chicago Creosoting Co.
Colman, The J. M. Co.
Eppinger & Russell Co.
Goltra Tie Co., The W. F.
Gulfport Creosoting Co.
Indiana Tie Co.
Indiana Zinc-Creosoting Co.
Int'l Creosoting & Construction Co.
Jennison-Wright Co.
Joyce-Watkins Co.
Kettle River Co., The
Michigan Wood-Preserving Co.
Moss Tie Co., T. J.
National Lumber & Creosoting Co.
Ohio Wood Preserving Co.
Pacific Creosoting Co.
Pacific Export Lumber Co.
Pittsburgh Wood Preserving Co.
St. Helens Creosoting Co.
St. Paul & Tacoma Lumber Co.
Southern Creosoting Co.
Southern Wood Preserving Co.

Zinc Chloride.

General Chemical Co.
Grasselli Chemical Co.

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DETACH AND MAIL TO THE SECRETARY-TREASURER, F J. ANGIER, MT. ROYAL STATION, BALTIMORE, MD.

American Wood-Preservers' Association

APPLICATION FOR MEMBERSHIP

Date.....191__

Name .....

P. O. Address.....

State.....

Position .....

With .....

Grade of Membership.....

Proposed by.....

For object of the Association and membership qualifications see Constitution in front part of this book.

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CARD PROCESS

ZINC CREOSOTE

ZINC CHLORIDE and CREOSOTE OIL are the two standard wood-preservatives, and have been considered so for many years. Zinc-Chloride used alone has the advantage of being a cheap treatment in first cost, but as the zinc has a tendency to leach from the wood, especially in wet climates, it may prove a costly treatment in the end. Creosote Oil is much more expensive, and if a sufficient amount is used to penetrate the heartwood, the cost of treatment is prohibitive for such materials as cross-ties, etc. The ideal treatment is to COMBINE the two preservatives, and USE ANY DESIRED AMOUNT OF EACH. This is successively accomplished by the CARD PROCESS. This is no experiment—has been in use for years, and now used by the following companies:

C., B. & Q. Railroad Company.
C. & N. W. Railroad Company.
Baltimore and Ohio Railroad Company.
C., M. & St. P. Railway Company.
Erie Railroad Company.
Twin City Railways.
Indiana Union Traction Company.
The Kettle River Company.
The National Lumber & Creosoting Company.
Chicago Creosoting Company.
Joyce-Watkins Company.
T. J. Moss Tie Company.
Indiana Zinc Creosoting Company.

¶Other Companies are negotiating for the use of this process, and plants now building are equipping their retorts with the Card apparatus to meet the rapidly growing demand for this method of treating railway cross-ties with standard preservatives. For particulars address

J. B. CARD, 30 N. LaSalle Street, Chicago, Ill.

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REPORT OF PROCEEDINGS
Thirteenth Annual Meeting

THE NEW YORK
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ASTOR, LENOX AND
TILDEN FOUNDATIONS

American Wood-Preservers' Association

AT NEW YORK, N. Y.
Nineteen Hundred and Seventeen

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BY
AMERICAN WOOD-PRESERVERS' ASSOCIATION

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Baltimore, Maryland

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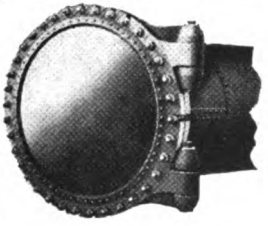
PROCEEDINGS

OF THE

Thirteenth Annual Meeting

OF THE

American Wood-Preservers' Association



HELD AT

HOTEL ASTOR, NEW YORK

JANUARY 23, 24, 25, 1917

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JOHN FOLEY
President, 1917

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THE NEW YORK
PUBLIC LIBRARY

ASTOR, LENOX AND
TILDEN FOUNDATIONS

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AMERICAN WOOD-PRESERVERS' ASSOCIATION

Constitution

(Amended 1912, 1915, 1916)

ARTICLE I.

Name and Objects.

SECTION 1. The name of this Association shall be the AMERICAN WOOD-PRESERVERS' ASSOCIATION.

SECTION 2. The objects of the Association shall be the promotion of knowledge of the materials, methods, and principles involved in the economic design, location, construction, maintenance, and operation of wood-preserving works; the standardization of specifications for wood preservatives and for their introduction into the material to be preserved; and the maintenance of high standards of business ethics in the wood-preserving industry.

SECTION 3. The means to be used for these purposes shall be meetings for the presentation and discussion of reports of the experiences and investigations of its members and others, for the interchange of ideas, and for social intercourse; the publication of desirable information; and co-operation with organizations or individuals in work affecting wood-preserving.

ARTICLE II.

Membership.

SECTION 1. The Association shall consist of Corporate, Associate, Probate, and Honorary members.

SECTION 2. A Corporate Member shall be an executive, an administrator, or an operative in a wood-preserving organization; an officer of a public-utility corporation using treated wood whose duties cover the purchasing, inspecting, treating, or distribution of such material; a chemist or an engineer in the employ of a city, county, state, nation, or public-utility corporation; a consulting chemical, civil, electrical, forest, or mechanical engineer; or a professor or an instructor in an institution of learning.

SECTION 3. An Associate Member shall be any person or association of persons interested in wood preservation or in the sale of material or equipment used in the wood-preserving industry.

SECTION 4. A Probate Member shall be an employe of a wood-preserving or inspecting organization who is not eligible for Corporate Membership.

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SECTION 5. An Honorary Member shall be a person of acknowledged eminence in the wood-preserving industry or the sciences relating thereto. The number of Honorary Members shall not exceed five.

SECTION 6. Corporate Members shall have all the rights and privileges of the Association.

SECTION 7. Associate Members shall have all the rights of Corporate Members, except those of voting or holding office.

SECTION 8. Probate Members shall have all the rights of Corporate Members, except those of voting or holding office, for five years from the date of their admission, when their status shall be determined by the Executive Committee.

SECTION 9. Honorary Members shall have all the rights of Corporate Members, except that of holding office, and shall be exempt from the payment of dues.

ARTICLE III.

Admissions and Expulsions.

SECTION 1. Applications for membership and resignations from membership shall be transmitted to the Secretary-Treasurer, the former on a form prescribed by the Executive Committee and endorsed by a Corporate or an Honorary Member. The Secretary-Treasurer shall forward a copy of each application for membership to each member of the Executive Committee, the affirmative votes of a majority of whom shall admit the candidate.

SECTION 2. Proposals for Honorary Membership shall be made by at least ten members, none of whom shall be a member of the Executive Committee. The nominee shall be declared an Honorary Member if he receives the unanimous vote of the Executive Committee or the votes of two-thirds of the Corporate and Honorary members.

SECTION 3. Any member of the Association who resigns while in good standing may be reinstated without paying a second admission fee, provided his application is approved by two-thirds of the Executive Committee.

SECTION 4. For unbecoming conduct a member may be expelled by the votes of two-thirds of the members at an Annual Meeting, after the member has been served with written particulars as to his offense by the Executive Committee, and had an opportunity to be heard by it or by the members at an Annual Meeting.

SECTION 5. The Executive Committee shall accept the resignation, tendered in writing, of any member whose dues are paid.

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ARTICLE IV.

Dues.

SECTION 1. On admission to the Association, members shall pay fees as follows: Corporate Members, $10.00; Associate Members, $15.00; Probate Members, $5.00, which shall include their first dues.

SECTION 2. The annual dues, payable during the first two months of the calendar year, shall be as follows: Corporate Members, $10.00; Associate Members, $10.00; Probate Members, $5.00.

SECTION 3. Members admitted after March 31 shall be exempt from the payment of dues until the following January 1, unless they desire to vote or to receive the current publications of the Association, in which case they shall pay one-half of the annual dues.

SECTION 4. Any member whose dues are unpaid on April 1 shall not receive the publications of the Association, and if his dues are not paid by December 31, his membership shall be canceled, except as provided for in Section 5 of this Article.

SECTION 5. The Executive Committee may extend the time for paying or remit the dues of any Corporate or Probate members who are unable to pay them.

ARTICLE V.

Officers.

SECTION 1. The officers of the Association shall be Corporate Members and shall consist of a President, a First Vice-President, a Second Vice-President, a Secretary-Treasurer, and six Members of Executive Committee, who, together with the last Past-President who is a Corporate Member, shall constitute the Executive Committee in which responsibility for the government of the Association shall be vested. The President shall be chosen from the nine eligible members of the Executive Committee.

SECTION 2. No two or more officers in any year shall be members of the same business organization.

SECTION 3. The President, the First Vice-President, the Second Vice-President, the Secretary-Treasurer, and two Members of Executive Committee shall be elected at each Annual Meeting.

SECTION 4. The terms of the President, Vice-Presidents, and Secretary-Treasurer shall begin at the close of the Annual Meeting at which they are elected and continue until their successors are elected and have qualified. The six Members of Executive Committee shall serve three years, two being elected each year.

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SECTION 5. A vacancy in the office of President shall be filled by the Vice-Presidents in order.

SECTION 6. A vacancy in any office other than that of President shall be filled by an appointee of the Executive Committee.

SECTION 7. The President shall not be eligible for re-election to that office until three others have filled it. A Vice-President shall not be eligible for re-election to the same office until one other has filled it.

ARTICLE VI.

Nomination and Election of Officers.

SECTION 1. At each Annual Meeting six Corporate Members who are not officers shall be elected, together with the three last Past-Presidents who are Corporate Members, to serve one year as a Nominating Committee, of which the senior Past-President shall be chairman.

SECTION 2. The Nominating Committee shall nominate one eligible member for each office and for each membership in the Nominating Committee and shall send its list of nominees to the Secretary-Treasurer before October 15. Any vacancies that may occur in the list of nominees before it is sent to the members shall be filled by the Executive Committee.

SECTION 3. The voting shall not be restricted to the names presented by the Nominating Committee. Any member may file with the Secretary-Treasurer before November 1 the name of a candidate for any office.

SECTION 4. The ballot, with envelopes for secret voting, shall be sent to each member before December 1. It must contain the names of all nominees for each office, arranged alphabetically where there is more than one name for any office, with the nominees of the Nominating Committee plainly indicated.

SECTION 5. Members may scratch or substitute the name of any nominee for any office.

SECTION 6. Ballots shall be sealed and sent or delivered to the Secretary-Treasurer before the polls close, prior to which time a voter may withdraw or replace his ballot.

SECTION 7. The polls shall be closed at noon on the first day of the Annual Meeting, and the ballots shall be counted by one Corporate and four Associate or Probate Members, appointed tellers by the presiding officer at the Annual Meeting.

SECTION 8. The persons who receive the highest number of votes for the offices for which they are candidates shall be declared elected. In case of a tie between candidates for the same office, the members pres-

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ent at the Annual Meeting shall elect the officer from the candidates so tied. The presiding officer shall announce to the meeting the names of the officers elected.

ARTICLE VII.

Management.

SECTION 1. The President shall have general supervision of the affairs of the Association, shall preside at its meetings and those of the Executive Committee, and shall be a member *ex-officio* of every committee except the Nominating Committee.

SECTION 2. The Vice-Presidents, in order of seniority, shall preside at meetings in the absence of the President, and discharge his duties in case of a vacancy in the office.

SECTION 3. The Secretary-Treasurer, under the direction of the President and the Executive Committee, shall be the executive officer of the Association. He shall conduct the correspondence of the Association; record the proceedings of all meetings; collect and deposit all moneys due the Association; verify all bills and pay them when approved by the President or Executive Committee; make at each Annual Meeting a report of the accounts and membership of the Association; and perform such other duties as may be assigned to him by the Executive Committee.

SECTION 4. The Executive Committee shall manage the affairs of the Association, and shall have full power to control and regulate all matters not provided for in the Constitution. It shall act on applications for membership; make appropriations for specific purposes; direct the care of the surplus funds of the Association; and audit the accounts of the Secretary-Treasurer.

SECTION 5. The Executive Committee shall publish the activities of the Association in a book to be known as the Annual Proceedings; but, subject to the action of the Association, it may withhold, in whole or in part, discussions, papers, or reports, the propriety or soundness of which it considers questionable.

SECTION 6. The Executive Committee shall have printed a Manual of Recommended Practice, in which shall be published the specifications and standards approved by the Association in accordance with Article X.

SECTION 7. The Executive Committee shall meet at such times and places as the President may direct, or five members may request in writing. Six members shall constitute a quorum.

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ARTICLE VIII.

Meetings.

SECTION 1. An Annual Meeting, at which the officers shall be elected and all annual reports read, shall be held on the fourth Tuesday in January of each year, at ten o'clock A. M., at such place as the Association at the previous meeting may designate.

SECTION 2. Whenever the President may deem it necessary, or upon the written application of fifteen Corporate Members, he shall direct the Secretary-Treasurer to call a special meeting. The call for such a meeting shall state the time, place, and purpose of the meeting, and shall be mailed not less than thirty days prior to the date of the proposed meeting.

SECTION 3. Twenty Corporate Members shall constitute a quorum at any meeting of the Association.

SECTION 4. The order of business at the meetings of the Association shall be arranged by the Executive Committee, subject to addition or change by the votes of the majority of the members present.

ARTICLE IX.

Amendments.

SECTION 1. Proposed amendments to this Constitution must be offered in writing, signed by at least five Corporate Members, and forwarded to the Secretary-Treasurer not less than thirty days prior to the Annual Meeting. They shall be published with the notices for the meeting.

SECTION 2. Proposed amendments shall be in order for discussion at the Annual Meeting, and may be amended and adopted if two-thirds of the votes of the Corporate and Honorary members present and voting are affirmative.

ARTICLE X.

Adoption of Standards.

SECTION 1. Any proposals for the approval or recommendation by the Association, of definitions, methods, nomenclature, specifications, standard construction, or standard practice, or aimed at defining formally the position of the Association on any matter of importance, shall be presented in writing, with drawings if necessary, at an Annual Meeting. At this meeting amendments may be made by a majority of the Corporate and Honorary members present and voting. Proposed standards shall be referred to letter ballot of the Association if two-thirds of the Corporate and Honorary members at an Annual Meeting vote affirmatively. The affirmative votes of two-thirds of all the Corporate and Honorary members shall be required for the adoption of any standard.

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Past and Present Officers of the American Wood-Preservers' Association.

Number	Year Elected.	President.	First Vice-President	Second Vice-President	Third Vice-President	Secretary-Treasurer
1st.....	1905	J. S. Baker	C. B. Lowry†	H. J. Whitmore†	F. A. Kummer*	C. W. Berry
2nd.....	1906	C. B. Lowry†	E. O. Faulkner	Edmund Christian	David Allerton	C. W. Berry
3rd.....	1907	C. B. Lowry†	David Allerton	Walter Buehler	H. S. Valentine	C. W. Berry
4th.....	1908	Walter Buehler	C. B. Lowry†	David Allerton	H. S. Valentine	C. W. Berry
5th.....	1909	Walter Buehler	David Allerton	H. S. Valentine	H. M. Rollins	C. W. Berry
6th.....	1910	Walter Buehler	C. W. Berry	David Allerton	C. D. Chanute†	F. J. Angier
7th.....	1911	John T. Logan	Andrew Gibson	R. J. Calder	D. Burkhalter	F. J. Angier
8th.....	1912	E. A Sterling	A. M. Smith	H. M. Rollins	G. B. Shipley	F. J. Angier
9th.....	1913	A. E. Larkin	J. H .Waterman	E. B. Fulks	Geo. E. Rex	F. J. Angier
10th.....	1914	Geo. E. Rex	Carl G. Crawford	R. S. Manley	F. B. Ridgway*	F. J. Angier
11th.....	1915	J. H. Waterman	H. S. Loud	Lowry Smith	F. D. Beal	F. J. Angier
12th.....	1916	Carl G. Crawford	John Foley	M. K. Trumbull	.....	F. J. Angier
13th.....	1917	John Foley	M. K. Trumbull	J. B. Card	.....	F. J. Angier

†Deceased. *Resigned.

In 1915 the Executive Committee was increased to 11 members, the 6 additional members to serve from 1 to 3 years. In 1916 the office of Third Vice-President was abolished.

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Meetings.

Year.	City.	Hotel.	Members Present.	Visitors Present.	Number of Pages in Proceedings.	Number of Papers and Reports Presented.
1905.....	New Orleans	St. Charles	15	No record	37	7
1906.....	Chicago	Palmer House	16	No record	56	9
1907.....	Memphis	Baltimore	16	No record	64	10
1908.....	Kansas City	Gayoso	No record	No record	Not issued	..
1909.....	Chicago	Auditorium	..	100	141	12
1910.....	Chicago	Auditorium	24	74	190	14
1911.....	Chicago	Auditorium	50	70	302	20
1912.....	Chicago	Sherman	67	..	348	17
1913.....	Chicago	Sherman	83	36	525	22
1914.....	New Orleans	St. Charles	65	43	544	25
1915.....	Chicago	Congress	122	105	527	23
1916.....	Chicago	Sherman	115	89	432	31
1917.....	New York	Astor	100	133	538	26

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OFFICERS.

John Foley.....President
M. K. Trumbull.....First Vice-President
J. B. Card.....Second Vice-President
F. J. Angier.....Secretary-Treasurer

EXECUTIVE COMMITTEE.

John Foley, *Chairman*

F. J. Angier
Carl G. Crawford
Geo. M. Davidson
A. R. Joyce
C. M. Taylor
J. B. Card
V. K. Hendricks
F. S. Pooler
Geo. E. Rex
M. K. Trumbull

Committee No. 1—Meeting.

M. K. Trumbull, *Chairman*

Program.
M. K. Trumbull, *Chairman*
J. B. Card
V. K. Hendricks
F. S. Pooler
Geo. E. Rex

Entertainment.
A. L. Kuehn, *Chairman*
F. S. Pooler
E. J. Roth
E. J. Stocking

Committee No. 2—Publications.

John Foley, *Chairman*

E. W. Bright
E. G. Draper
Wm. A. Fisher
C. E. Gosline
Frank Schilling
L. B. Shipley

Committee No. 3—Promotion and Education

E. A. Sterling, *Chairman*

John S. Bates
Nelson C. Brown
F. V. Dunham
E. T. Howson
S. J. Record
P. S. Ridsdale
Chas. C. Schnatterbeck
O. T. Swan

Committee No. 4—Service Tests.

P. R. Hicks, *Chairman*

Ties and Timber.
E. H. Bowser, *Chairman*
C. F. Ford
W. H. Fulweiler
F. D. Mattos
H. M. Rollins
H. von Schrenk

Flooring and Paving.
A. W. Dow, *Chairman*
F. D. Beal
E. R. Dutton
L. T. Ericson
R. S. Manley
J. C. Williams

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Committee No. 5—Plant Operation.

C. W. Lane, *Chairman*

G. S. Harden
Geo. M. Hunt
A. M. Lockett
H. S. Loud
August Meyer
E. E. Pershall
R. H. Rawson
J. M. Weber

Committee No. 6—Preservatives.

E. B. Fulks, *Chairman*

S. F. Acree
S. R. Church
C. N. Forrest
A. L. Kammerer
O. C. Steinmayer
C. M. Taylor

Committee No. 7—Purchase and Preservation of Treatable Timber.

A. R. Joyce, *Chairman*

J. B. Card
O. P. M. Goss
F. R. Martin
Geo. E. Rex
H. S. Sackett
M. T. Shanesey
Lowry Smith
T. G. Townsend
H. S. Valentine
C. P. Winslow

Committee No. 8—Wood-Block Flooring and Paving.

Clyde H. Teesdale, *Chairman*

Walter Buehler
Frank W. Cherrington
A. L. Kuehn
H. M. Newton
A. H. Noyes
Albert Stamford

Committee No. 9—Terminology.

J. B. Card, *Chairman*

F. J. Angier
W. H. Grady
J. H. Grow
Grant B. Shipley

Committee No. 10—Non-Pressure Treatments.

R. A. Griffin, *Chairman*

W. M. Carpenter
E. T. Chapin
L. L. Hill
Roger F. Hosford

Committee No. 11—Conference.

Carl G. Crawford, *Chairman*

E. T. Howson
J. H. Waterman

Committee No. 12—Nominating.

Geo. E. Rex, *Chairman*

J. H. Waterman
Carl G. Crawford
Wm. A. Fisher
E. T. Howson
Richard V. Look
F. D. Mattos
August Meyer
A. H. Noyes

NOTICE—The Association is not responsible as a body for the opinions expressed by individuals.

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MEMBERS.

c-Corporate. a-Associate. p-Probate. h-Honorary.
Figures indicate serial number of Membership Certificates.

324 c ACREE, S. F.....In charge Section of Derived Products, Forest Products Laboratory, Madison, Wis.
354 c ADAMSON, G. J.....Division Engineer, Union Pacific System, Cheyenne, Wyo.
183 c ALEXANDER, E. E.....General Foreman, Timber Preserving Plant, Baltimore and Ohio R. R. Co., Green Spring, W. Va.
29 c ALLARDYCE, R. L.....Supt., International Creosoting & Construction Co., Texarkana, Tex.
360 a ALLEN, E. J..... Ties and Lumber, 32 Broadway, New York.
21 c ALLERTON, DAVID.....Carlotta, Cal.
1 c ANGIER, F. J.....Supt. of Timber Preservation, Baltimore and Ohio R. R. Co., Baltimore, Md.
274 c APPEL, HARRIS A.....Engineer, S. P. F. Wood-Preserving Co., 90 Wall Street, New York.
2 c ARMSTRONG, R. L.....636 Burdette St., New Orleans, La.
105 c BACON, W. L.....Supt., Tie Treating Plant, C. & N. W. Ry., Escanaba, Mich.
3 h BAKER, J. S.....Box 22, Paducah, Ky.
167 c BATEMAN, ERNEST.....Chemist, Forest Products Laboratory, Madison, Wis.
246 c BATES, JOHN S.....Supt., Forest Products Laboratories, McGill University, Montreal, Canada.
88 c BATSON, C. D.....Mgr., Republic Creosoting Co., Mobile, Ala.
361 c BATTENHOUSE, WM.... Supervisor Maintenance of Way and Equipment Lumber, Baltimore and Ohio R. R., Baltimore, Md.
4 c BEAL, F. D.....Engineer, 414 Insurance Exchange, San Francisco, Cal.
255 c BEATY, R. ERNEST.....Expert Inspector, Borough of Manhattan, Room 3002, 165 Broadway, New York.
198 c BECKER, A. C.....Terminal House, St. Louis, Mo.
145 c BELCHER, R. S.....Supt., Treating Plant, Santa Fe Tie & Lumber Preserving Co., Somerville, Tex.
144 c BERK, P. F.....Chemical Manufacturer, F. W. Berk & Co., Ltd., 1 Fenchurch Ave., London, England.
5 h BERRY, C. W.....Consulting Engineer, care of J. B. Berry, Transportation Bldg., Chicago, Ill.
300 c BLACK, JAMES M.....Paving Block Expert, 203 Pasadena Apartments, Jefferson & Du Bois Sts., Detroit, Mich.
22 c BOEHNE, E. E.....Mgr., Sales Department, International Creosoting & Construction Co., Galveston, Tex.
258 c BOOK, J. E.....Treating Engineer, Pacific Creosoting Co., Creosote, Wash.
244 c BOWSER, E. H.....Supt. of Timber Department, I. C. R. R., Memphis, Tenn.
267 a BOYD, J. L.....Chief Engineer, Creosoted Block Paving Co., Royal Bank Bldg., Toronto, Canada.
280 p BRENNAN, T. S.....Lumber Inspector, A., T. & S. F. Ry., Box 503, Ballard Station, Seattle, Wash.
368 a BREYER, FRANK G.....Chief of Research Dept., New Jersey Zinc Co., Palmerton, Pa.
301 c BRIGHT, EDGAR W.....Tie & Timber Agent, Boston Elevated Rwy. Co., 101 Milk St., Boston, Mass.
340 c BROWN, FRANK I.....Lumber Agent, Penna. Lines West of Pittsburgh, Fort Wayne, Ind.
230 c BROWN, NELSON C.....Professor of Forest Utilization, New York State College of Forestry, Syracuse, N. Y.
122 c BRUNING, HEINRICH...(Robert A. Munro & Co., 31 Liberty St., New York) Hubertusmuhle, Schopfurth, Mark, Germany.
23 c BUEHLER, WALTER.....Consulting Engineer in Wood Preservation, The Barrett Co., 10 So. La Salle St., Chicago, Ill.
24 c BURKHALTER, D.....American Creosoting Co., Box 77, Russell, Ky.
338 c BURY, RICHARD A.....Asst. Gen. Tie Agent, N. Y. C. Lines, 76 Seward Ave., Detroit, Mich.

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83 a CABOT, SAMUEL.....Manufacturing Chemist, 141 Milk St., Boston, Mass.
30 c CALDER, R. J.....Secy.-Treas., International Creosoting & Construction Co., Galveston, Tex.
190 c CAMPBELL, J. H.....Chemical Engineer, R. W. Hunt & Co., 2200 Insurance Exchange, Chicago, Ill.
43 c CARD, J. B.....Prest., Central Creosoting Co., 111 W. Washington St., Chicago, Ill.
352 c CARPENTER, W. M.....Vice-Prest., American Cross Arm Co., McCormick Bldg., Chicago, Ill.
276 c CECIL, WM. A.....Wood-Preserving Engineer, Indiana Tie Co., Citizens National Bank Building, Evansville, Ind.
257 c CHADBOURNE, B.....Asst. Supt., Pacific Creosoting Co., Northern Life Bldg., Seattle, Wash.
302 c CHAPIN, E. T.....Prest., The E. T. Chapin Co., Columbia Bldg., Spokane, Wash.
69 c CHERRINGTON, F. W....Chief Engr., Jennison-Wright Co., 313 Huron St., Toledo. O.
19 c CHRISTIAN, EDMUND...Gen. Mgr., Norfolk Creosoting Co., Norfolk, Va.
57 a CHURCH, SUMNER R....Manager, Research Dept., The Barrett Co., 17 Battery Place, New York.
165 c CLARKE, G. S..... Vice-Prest. & Gen. Mgr., The Reeves Co., 809 Whitney-Central Bldg., New Orleans, La.
184 c CLARK, W. DENNISON..Vice-Prest. & Gen. Mgr., Columbia Creosoting Co., 810 Lewis Bldg., Portland, Ore.
318 c CLEMENTS, A. B..... Vice-Prest., United States Wood Preserving Co., 165 Broadway, New York.
319 p CLEMENTS, CYRIL M...Salesman, The Barrett Co., Philadelphia, Pa.
174 c CLIFTON, W. H..... Lumber Agent, Baltimore & Ohio R. R. Co., Baltimore, Md.
249 c COBEAN, CHAS. E.....Supt., Pacific Creosoting Co., Creosote, Wash.
188 a COCKE, W. H.....Prest., Commercial Acid Co., 3943 Duncan Ave., St. Louis, Mo.
157 c COLLIER, H. L.....Chief of Construction City of Atlanta, Atlanta, Ga.
365 c COLLINS, E. S.....Prest., Sheffield & Tionesta Rwy. Co., Kellettville, Pa.
218 c COLLIVER, S. R.....Treatment Inspector, A., T. & S. F. Ry., Topeka, Kan.
67 c COLMAN, GEO. A.....The J. M. Colman Co., Colman Bldg., Seattle, Wash.
366 c CONWAY, JOHN L..... Supt., Pittsburgh Wood Preserving Co., Connellsville, Pa.
221 c COOPER, S. D.....Chief Inspector, A., T. & S. F. Ry., Topeka, Kan.
31 c CRAWFORD, CARL G....Gen. Mgr., American Creosoting Co., 808 Columbia Bldg., Louisville, Ky.
80 c CURTIS, W. W.....Prest. & Treas., The Rapson Coal Mining Co., Box 485, Colorado Springs, Colo.
25 c DAVIDSON, G. M.....Chemist and Engineer of Tests, C. & N. W. Ry. Co., Chicago, Ill.
143 c DAVIES, E. T.....Inspector, City Engineer's Office, Minneapolis, Minn.
84 c DE CEW, J. A.....Chemical Engineer, McGill Bldg., Montreal, Canada.
272 c DELIUS, E. A.....Bookkeeper, Pacific Creosoting Co., Northern Life Bldg., Seattle, Wash.
204 c DEMUTH, R. E.....Testing Engineer, 22 Hayward Ave., Baltimore, Md.
223 c DIXON, G. C.....Tie Treating Inspector, N. Y. C. Lines, Box 763, Indianapolis, Ind.
64 c DIXON, J. H.....Forestry Branch, Department Natural Resources, Care of Chief Engineer, Canadian Pac. Ry., Winnipeg, Canada.
119 c DOUGHERTY, CURTIS...Chief Engineer, Queen & Crescent R. R., Cincinnati, O.
303 c DOVEY, J. THOMAS.....Prest., The Seattle Engineering Co., 724 Central Building, Seattle, Wash.
290 c DOW, ALLAN W.....Consulting Engineer, Dow & Smith, 131 E. 23rd St., N. Y.
121 c DRAPER, E. G.....Prest., American Creosoting Co. of N. J., 17 Battery Place, New York.
166 a DREFAHL, LOUIS C.....Chemist, Grasselli Chemical Co., 880 The Arcade, Cleveland, O.
353 c DRINKER, LLOYD P.....Eastern Representative, The Jennison-Wright Co., 906 Crozer Bldg., Philadelphia, Pa.
93 c DRINKER, W. W.....Asst. Engineer, Erie R. R., 50 Church St., New York.
369 a DUNHAM, F. V..... Mgr., Wood-Block Paving Promotion, Southern Pine Assoc., New Orleans, La.

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178 c **DUNSTAN, J. H.**.....Supt., Southern Creosoting Co., Slidell, La.
211 c **DURHAM, J. H.**.....Vice-Prest., American Creosoting Co., Louisville, Ky.
322 c **DUTTON, ELLIS R.**.....Asst. City Engr., City Hall, Minneapolis, Minn.
202 a **EASTWICK, CHAS. H.**...Prest., The Northeastern Co., 6 Beacon St., Boston, Mass.
297 a **ELLIOTT, J. A.**.....Prest., J. A. Elliott Tie Co., 1609 Mound Ave., Jacksonville, Ill.
275 c **EMERSON, HARRINGTON** Prest., The Emerson Co., 30 Church St., New York.
76 c **EPPINGER, JESSE I.**....Gen. Mgr., Eppinger & Russell Co., 165 Broadway, New York.
163 c **ERICSON, L. T.**.....Contracting Engineer, The Jennison-Wright Co., Toledo, O.
349 c **EVERHART, LAY H.**....Lt. Com., U. S. Navy, 161 Green St., Annapolis, Md.
341 p **FAIRLEY, ROBERT H.**...Foreman, St. Helens Creosoting Co., St. Helens, Oregon.
158 c **FANT, A. E.**.....Gen. Mgr., Gulfport Creosoting Co., Gulfport, Miss.
9 h **FAULKNER, E. O.**.....Mgr., Tie & Timber Dept., A., T. & S. F. Ry., Kerckhoff Bldg., Los Angeles, Cal.
159 a **FENN, FRANK D.**.....Mgr., Railroad Sales Dept., The Crane Co., 836 So. Michigan Ave., Chicago, Ill.
239 c **FERGUSSON, HUBERT.**.Gen. Mgr., Burt, Boulton & Haywood, Ltd., Prince Regent's Wharf, Silverton, Victoria Docks, London, England.
237 c **FINKE, W. F. H.**.....Tie & Timber Agent, Southern Ry. Co., Washington, D. C.
62 c **FISHER, WM. A.**.....Care of Lembcke, von Bernuth Co., 171 Madison Ave., New York.
308 a **FOERSTERLING, DR. H.**.Vice-Prest., Roessler & Hasslacher Chemical Co., 380 High St., Perth Amboy, N. J.
77 c **FOLEY, JOHN**.....Forester, P. R. R. Co., Broad St. Station, Philadelphia, Pa.
106 c **FORD, C. F.**.....Supt., Tie and Timber Dept., C., R. I. & P. R. R., 325 LaSalle St. Sta., Chicago, Ill.
296 c **FORREST, CHAS. N.**.....Chief Chemist, Barber Asphalt Paving Co., Maurer, N. J.
313 c **FOWLER, J. W.**.....9 Eighth Ave., Brooklyn, N. Y.
117 c **FREY, GEO. W.**.....Secy.-Treas. & Mgr., Compressed Wood Preserving Co., 4600 Spring Grove Ave., Cincinnati, O.
333 c **FRISTOE, J. W.**.....Prest., T. J. Moss Tie Co., Security Building, St. Louis, Mo.
347 c **FRITZ, CHAS. C.**.....Supervisor, Timber Preservation, Long Bell Lumber Co., R. A. Long Bldg., Kansas City, Mo.
38 c **FULKS, E. B.**.....Vice-Prest., American Tar Products Co., 208 S. LaSalle St., Chicago, Ill.
160 a **FULWEILER, W. H.**.....Chemist, United Gas Improvement Co., 1706 N. Broad St., Philadelphia, Pa.
306 a **FURLONG, L. A.**.....Vice-Prest., The Valentine-Clark Co., Security Bldg., Minneapolis, Minn.
39 c **GIBSON, ANDREW**.....Engineer Maintenance of Way, No. Pac. Ry., St. Paul, Minn.
180 a **GIBSON, W. C.**.....Sales Engineer, Allis-Chalmers Mfg. Co., Milwaukee, Wis.
316 p **GOLDSTEIN, H. I.**.....Highway Inspector, Bureau of Highways, Dept. of Public Works, 4200 Woodland Ave., Philadelphia, Pa.
56 c **GOLTRA, W. F.**.....Prest., W. F. Goltra Tie Co., Rockefeller Bldg., Cleveland, O.
288 c **GOSLINE, C. E.**.....Treating Inspector, D., L. & W. R. R. Co., Paterson, N. J.
277 c **GOSS, O. P. M.**.....Consulting Timber Engineer, White Bldg., Seattle, Wash.
243 c **GRADY, W. H.**.....Asst. Gen. Supt., American Creosoting Co., Louisville, Ky.
100 c **GRAHAM, FLOYD N.**....Inspector Engineering Dept., C. G. W. R. R., 156 Sumner St., Galesburg, Ill.
170 c **GREEN, DONALD W.**....Secy., Columbia Creosoting Co., 809 Lewis Bldg., Portland, Ore.
232 c **GRIFFIN, RUSSELL A.**..Mgr., Pole Dept., Western Electric Co., 195 Broadway, New York.
334 c **GRIGGS, E. G.**.....Prest., St. Paul & Tacoma Lumber Co., Tacoma, Wash.
321 c **GRIMES, I. B.**.....Plant Supt., National Lumber & Creosoting Co., Houston Tex.
72 a **GROW, J. H.**.....Engineer in Wood Preservation, Allis-Chalmers Mfg. Co., Milwaukee, Wis.
231 c **HAGGANDER, G. A.**.....Asst. Bridge Engineer, C., B. & Q. R. R., 547 W. Jackson Blvd., Chicago, Ill.
220 c **HALL, CHAS. S.**.....Southern Pine Association, 624 Union St., Brunswick, Ga.
195 c **HAMILTON, F. P.**.....301 Queen & Crescent Bldg., New Orleans, La.

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358 c HAMMACK, M. D.....Treating Inspector, Missouri Pacific Rwy. Co., Madison, Ill.
214 c HAMNETT, W. S.....Vice-Prest. & Mgr., Pittsburgh Testing Laboratory of Texas, 305 Praetorian Bldg., Dallas, Tex.
213 c HARDEN, G. S.....Supt., Timber Preserving Plant, B., R. & P. Ry., Bradford, Pa.
187 c HARRIS, PAGE.....Vice-Prest., National Lumber & Creosoting Co., Houston, Tex.
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Winslow, Carlile P.

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RUSSIA:
Sapojnikoff, Serge

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Card, J. B.
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Chapin, E. T.
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Goldstein, H. I.
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Townsend, T. G.
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von Bernuth, O. M.
von Schrenk, Hermann

Waterman, J. H.
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Williams, J. C.

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ADAMS, WINSTON D. ..... Commercial Agent, Bureau of Foreign and Domestic Commerce, New York.
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ANGIER, ROBERT N. ..... Baltimore, Md.
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KINGSLEY, F.....Associate Editor, "Electric Railway Journal," New York.
KIEFF, MRS. HELENE.....New York.
KRUSE, R. F.....Southern Representative, Carbolineum Wood-Preserving Co., New York.
LEAVITT, CLYDE.....Forester, Conservation Commission of Canada, Ottawa.
LEWIS, MRS. W. H.....Chicago, Ill.
LITTLE, J. G.....Editor, Simmons & Boardman Publishing Co., New York.
LITTELL, W. B.....American Forestry Association, Washington, D. C.
LOVETT, A. G.....General Manager, Mogul Co., New York.
LUCAS, F. F.....Engineer, Western Electric Co., New York.
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MUSSELMAN, C. B.....Treating Inspector, Lehigh Valley R. R., Bound Brook, N. J.
NAYUDU, G. K.....Assistant Conservator of Forests, Bangalore, Mysore, India.
OSBORNE, CLYDE.....Superintendent, Ayer & Lord Tie Co., Carbondale, Ill.
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ROBERTS, MRS. G. W.....Spokane, Wash.
ROBISON, MRS. N. S.....Minneapolis, Minn.
ROCKWOOD, NATHAN C.....Associate Editor, "Engineering News," New York.
ROEHRICK, VICTOR H.....Director, Municipal Testing Laboratories, St. Paul, Minn.
RICHARDSON, CLIFFORD.....Consulting Engineer, Barber Asphalt Paving Co., New York.
SAUMS, GEO. W.....President, Geo. W. Saums Co., Plainfield, N. J.
SCHLUDE, JOHN N.....Secretary and Treasurer, Carbolineum Wood-Preserving Co., New York.
SHANESEY, MRS. M. T.....Ann Arbor, Mich.
SHEPPARD, CHAS. C.....Chemist, Port Reading Creosoting Co., Port Reading, N. J.
SMITH, H. H.....Salesman, Middletown, N. Y.
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STERLING, MRS. E. A.....Chicago, Ill.
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STEWART, MRS. F. H.....Crumps Park, Ga.
STEWART, MISS CLAIR LEE...Macon, Ga.
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TAYLOR, G. M.....Cornell University, Department of Forestry, Ithaca, N. Y.
TAYLOR, MRS. C. M.....Elizabeth, N. J.
TOOMEY, E. H.....Secretary, S. P. F. Wood-Preserving Co., New York.
VAIL, REV. CHAS. H.....Brooklyn, N. Y.
VARIAN, ARTHUR.....Representative, Eppinger & Russell Co., New York.
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WEISS, J. M.....Chief Chemist, The Barrett Co., New York.
WETHERILL, SAMUEL.....Salesman, Barber Asphalt Paving Co., Philadelphia, Pa.
WETMORE, WILLARD, C.....Representative, The Northeastern Co., New York.
WHITBECK, ROSS M.....Carbolineum Wood-Preserving Co., New York.
WOODHEAD, DANIEL W.....Sales Manager, Central Electric Co., Chicago, Ill.
WOODHEAD, MRS. D. W.....Chicago, Ill.
WRIGHT, GEO. D.....Vice-President, Consolidated R. M. & F. Co., Mexico City, Mex.
YOUNG, E. V.....Inspector, Dow & Smith, New York.

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PROGRAM.

TUESDAY MORNING.

Opening by Prayer.....Rev. Dr. Charles H. Vail
President's Address.....Carl G. Crawford
Report of Entertainment Committee.....Jesse I. Eppinger, Chairman
Report of Secretary-Treasurer.....F. J. Angier
Communications.

TUESDAY AFTERNOON.

Report of Committee on Publicity, Promotion and Education, E. A. Sterling, Chairman
Report of Committee on Terminology.....J. B. Card, Chairman

WEDNESDAY MORNING.

Report of Committee on Service Tests of Ties and Structural Timber, C. P. Winslow, Chairman
Report of Committee on Plant Operation.....A. L. Kuehn, Chairman
Report of Committee on Preservatives.....E. B. Fulks, Chairman
Discussion of Report of Committee on Preservatives.....Wm. A. Fisher
Discussion of the Paving-Oil Specifications Proposed by the Joint Committees of the American Society for Testing Materials, American Society of Municipal Improvements, Southern Pine Association, American Society of Civil Engineers and the American Wood-Preservers' Association.....Ernest Bateman
Discussion of Report of Sub-Committee B of Committee on Preservatives, Ellis R. Dutton

WEDNESDAY AFTERNOON.

The Bad and the Good in the Handling of Wood, J H. Waterman and George E. Rex
The Grouping of Ties for Treatment.....C. P. Winslow
Report of Committee on the Purchase and Preservation of Treatable Timber.....A. R. Joyce, Chairman
Discussion of Report of Committee on the Purchase and Preservation of Treatable Timber.....F. S. Pooler
Seasoning Timber.....R. H. Rawson
The Tie Supply.....O. C. Steinmayer

THURSDAY MORNING.

Report of Committee on Service Tests of Wood-Block Paving, L. B. Moses, Chairman
Report of Committee on Wood-Block Paving.....C. H. Teesdale, Chairman
Appendix to Report of Committee on Wood-Block Paving, C. H. Teesdale and John A. Newlin
Report of Committee on Resolutions.....Wm. A. Fisher, Chairman
Election of Officers.

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OPENING SESSION.

The Thirteenth Annual Meeting of the American Wood-Preservers' Association, held at Hotel Astor, New York, January 23, 24, 25, 1917, was called to order by its President, Mr. Carl G. Crawford, Tuesday morning, January 23, at 10.30 o'clock.

THE PRESIDENT: Ladies and Gentlemen: The Thirteenth Annual Meeting of the American Wood-Preservers' Association is now called to order. We will be led in prayer by Dr. Vail.

REV. DR. CHARLES H. VAIL: Let us invoke the Divine blessing.

Oh Thou Eternal One, whose presence fills all space and occupies all time and who has thy dwelling place in every humble heart that trustingly looks up to Thee. We assemble here, Heavenly Father, at the beginning of this convention, feeling our need and dependence upon Thee as the giver of every good and perfect gift. We would ask, oh God, that Thou would be with the deliberations of this Association; that they may feel in the work they are doing that they are helping to make this world a better and more economic world in which to live; that we are co-workers with Thee, and that in their efforts to preserve the natural elements of nature, in their efforts to preserve the wood about us that they are indeed co-workers with Thee. And so we would feel indeed that we can ask Thy blessings upon this meeting here assembled. Be with its deliberations, be with the officers, oh God, and members that are here assembled and give them Thy spirit as Thou sees they may need, and help them to feel in all these things that they are working in harmony with Thee, that they are helping to advance civilization, that they are building up indeed those things that shall work for righteousness, and thus they are laying foundations for a noble humanity.

Be with us and help us, Heavenly Father, we will pray for the forgiveness of all our sins of omission and commission. Lead us by Thy spirit, keep us ever in Thy way and in Thy will. Again, our Heavenly Father, we would commend unto Thee the members of this Association; be with them in the days in which they shall convene here. Help them, our Heavenly Father, to be guided by Thy will and thus feel, indeed, that what is done may be done in Thy spirit and in Thy name and may be done for the bettering and uplift of the world. Thus they may be, indeed, co-workers with Thee in the affairs of Thy Kingdom. At last bless us and save us all, we would ask in Thy name and Thy spirit. Amen.

THE PRESIDENT: The next is the minutes of the last meeting. These have been published and placed in your hands, and we will dispense with reading of the minutes, unless they are called for. If there is no objection these minutes stand approved. They are approved.

The President then addressed the meeting as follows:

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PRESIDENT'S ADDRESS.

To the Members of the American Wood-Preservers' Association:

When you revised our Constitution at our last annual meeting you did not make it obligatory upon your President to deliver an annual address. But in considering the position of your President and the Executive Committee, and their opportunities for studying conditions and needs of the Association during the year in which they administered its affairs, I felt that it might be well worth while to take a few minutes at the beginning of this meeting to address you, with the hope that I might be able to say something that would help to strengthen the Association and better its condition.

After having served a year as your President I realize more fully than ever before that your President and Executive Committee, if they feel the responsibility placed upon them, and do the work required by the Association in order to make more firm its foundation, raise its standard, stimulate its growth and strengthen its purpose in promoting the industry, as your administrative officers must necessarily make a careful study of the history of the Association from its beginning together with its present status, with careful regard for the work it is now doing and the work it is to do in the future. This study of conditions which they are compelled to make places your President and Executive Committee on vantage ground more favorable perhaps than that of other members for observing the difficulties and needs of the Association.

Therefore, it might be well at this time to call to the minds of the members the growth of the Association in the past, its present position with regard to the industry, and the place it occupies with other industries and their official organizations, that we may obtain a better insight into the future and see the needs of our Association and the work to be done to strengthen and better it. I shall, therefore, recite briefly the history of this Association up to the present time, and try to point out as I do some of the difficulties it has had to overcome.

This Association had its inception at Perth Amboy, N. J., in March, 1904, at a little meeting of less than a dozen men engaged in wood preservation. Those men, of whom your President was one of the number, gathered there for the purpose of witnessing some tests in trying out one of the modern processes which was then being exhibited for the first time in this country, and is now one of the leading processes in use. There were present at this meeting men who were the oldest operators in the industry, some of whom have since passed away. It was stated by them that, to their knowledge, there never had been so many men engaged in the industry gathered together at any one time as there were at this small meeting, and I can say to you gentlemen

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here today that that was about the livliest meeting of Wood-Preservers I have ever attended in my life. Each man held a different view as to the best way to treat timber, and each was equally positive that he was right. Discussions were frequent, continuous and heated.

It was there decided that those engaged in the industry should get together frequently in the future and discuss the best methods of preserving timber and other problems which might help to promote the industry. There was a meeting during that summer at the World's Fair in St. Louis, and this Association was organized with its first annual meeting to be held in New Orleans in January, 1905. There have been altogether twelve annual meetings, and we are now assembled for the thirteenth. The first of these meetings were stormy. Discussions during the meetings and between members when the Association was not in session were heated, and often incurred much illwill. Each member seemed to feel that his own wonderful knowledge of the art was being doubted and that something might be said, or some steps taken, that would greatly injure him or his company. Others seemed to take the position that they must have their own ideas of the art and the methods employed by them and their companies endorsed at these meetings, if they expected to remain in the industry. It can easily be seen by those here today that methods and processes in wood preservation involve such deep technical points that it is little wonder it was hard to reconcile these differences of opinion at that time, even when members were honest in their convictions and advanced their opinions solely for the good of the Association and the profession. But when selfish ulterior motives were at the foundation of their actions it is little wonder that the members could not reach conclusions or come to any definite decisions in their work. And as a word of encouragement let me say that this element, sometimes referred to as "commercialism," was much more prevalent during the early days of the history of this Association than it has been in later years. Perhaps this difficulty of certain members working for special interests and attempting to use the Association in their behalf has been the greatest one that this Association or any other association representing its industry has had to overcome—if we have yet overcome it. This difficulty was so great during the early days of the Association that for a number of years little or no attempt was made to prepare programs which would bring up technical points, and perhaps the first half dozen annual meetings were held with the idea of merely promoting good fellowship among its members and having a good sociable time.

I have recalled this bit of our Association's history more as a defense for our present position in not having advanced further during the twelve or thirteen years the Association has been in existence, than for any other purpose. For the last half dozen years, however, the history of the Association has been different. The membership has

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grown rapidly. The field has become broader and men of new ideas have been brought into the Association. Technical problems have been discussed and without any serious consequences, and a little later in this address I hope to point out to you some of the achievements we have accomplished of which we are proud. But before doing this I would like to consider with you a few points which appeal to me as measures that will add strength and purpose to our Association, and I hope in doing this I am also voicing the thoughts of the rest of the members of the Executive Committee.

During the year I have observed that there is a lack of proper spirit and loyalty on the part of many members of the Association. In fact, I may say, all the members of the Association, for in speaking of loyalty I refer more particularly to the lack of unity or individuality due to lack of loyalty which our Association should possess in order that it may take its proper place as the official organization of our industry among the official organizations of other industries. It might be said that this Association in the past has not commanded the respect and confidence which it should have commanded. There is no industry in our country that is so far reaching and which affects the welfare of society and our government in protecting its natural resources as that of wood preservation. Therefore the industry should have and must have an organization which is representative of the value and prominence of the industry, which will give the industry the proper backing and serve as a mouthpiece whenever our rights are invaded. The industry will greatly suffer without such an organization.

How can we best build up this Association and give it the strength and create the confidence it deserves? I believe I have already touched upon the most vital point, which has been the means of holding it back, namely, too strong an element of commercialism, the lack of unity and individuality, too wide a divergence of opinion and the failure of some to see that the very best way to promote their own private position and business is to bend every effort to build up an organization in the industry which will demand the respect and confidence of every other business. So long as members come to these Association meetings with the idea of using them in a way which will sacrifice the best interests of the Association in order to bring quicker and greater returns to their own business, if such still is the case, so long will our Association fail to take the place it should. Whenever our Association acquires that strength of unity and individuality and creates a spirit of loyalty and self-pride which will give it sufficient strength to cause any member or individual to tremble with fear of bringing down upon himself righteous indignation whenever he starts promoting any plan or idea which will weaken the Association rather than strengthen it, just as much as though he had insulted an individual, then this difficulty will have been forever removed from this Association.

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Perhaps next to this point a feature which will help to build up our organization is a better appreciation of the value such an organization as I have described will have on the industry and in each and every individual business. Rather than quibble among ourselves in the industry as to just who shall control this or that piece of business if we look to promoting wood preservation in its truest sense and drawing the attention of those using forest products to the great economical advantages gained by having a larger part of their products chemically treated, and thus make them serve their greatest length of life, each business organization represented in this Association will derive a greater profit.

There is also a tendency on the part of those engaged in the operation of treating plants for railroads who own their own plants, to believe that this organization cannot be of any great value to them: that it can be only of advantage to those engaged in the commercial end of the field, and that it rests with them to provide the technical information for the industry. I certainly am not in sympathy with this view, and I hope that I may be counted among the majority of the members of this Association in taking this stand. When any department of a railroad takes the stand that it needs no outside help or is not called upon to cooperate with other men or organizations representing the same profession, that department is likely to become a weak and sickly one in that railroad and the entire railroad is going to suffer from such a policy.

Therefore, gentlemen, you and your business are bound to derive a greater benefit from this organization when it is given the strength and standing it deserves than from any other means that you by your efforts can inaugurate and build up. When you deride or belittle this Association you are doing more to injure your own personal standing and that of your business than you can by any other step you may take. Let us as members of this Association get a true appreciation of its value before us and when we do that I will have no fear that others in other lines of industry will gain the same high appreciation of our value, or that we will be enabled to defend it and over-ride any obstacle which may be placed in our path. By gaining this view of our own value and working together with the hope of placing the Association on the plane on which it belongs, we will wipe out any lack of harmony or lack of unity which has existed in the past.

Gentlemen, let me say that I would rather attack a man with all the implements of modern warfare in his hands, if he lacks pride in himself as a man, or has no self-respect, than I would a man with bare hands, but who has a strong sense of loyalty to himself; one who becomes doubly incensed when his rights are invaded; one who is possessed with a spirit of pride and a right of defense when the most noble aims he possesses are frustrated. As it is with an individual,

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so it is with a collection of individuals or an organization. And I would rather see this organization possessed with a proper spirit of loyalty and self-esteem, if I wished to gamble on its success, than to see it possessed of all the rules or concrete methods known to mankind for overcoming its difficulties.

There has also been a spirit of discouragement manifesting itself at times recently in the past. As it became necessary for our officers and committeemen to encounter some of the difficulties which I have just mentioned they became discouraged, and felt that these difficulties could never be removed, and at times have seemed to lose hope of accomplishing through this organization the work which they have been asked to do. Your Executive Committee has had to deal with many of these perplexing problems this year and to do all they could to encourage and stimulate to their greatest efforts the members in whose hands work has been entrusted. It is because of these perplexing problems with which we have had to deal that I have seen fit to address you on the subjects which I have brought up this morning. Your Executive Committee is now placed in the position that in order to carry on more constructive work it must adopt more stringent rules and methods in order to deal with these difficulties, or you yourselves as members must furnish sufficient strength and backing as an Association to overcome them. It is the sense of the Executive Committee that as we restrict action and freedom, either in presenting our programs or promoting discussions, we thereby weaken our organization and hinder its growth. Therefore, it has been with the idea of preventing such action by the Executive Committee that I have pointed out to you this morning the foundation of these difficulties with a possible means of overcoming them. From what I have already said I would not have you get the idea that the history of this Association has been merely one of difficulties and drawbacks without accomplishments. These difficulties and hindrances have been pointed out to you merely with the idea of overcoming them, and to assure you that we can overcome them I merely need to mention the accomplishments we have already attained.

During the greater part of the past in the life of this Association it did little or no constructive work. It considered and deliberated over methods and processes in use rather than created anything of its own. This to my mind is one of the reasons why the Association has not gained greater strength and made more rapid growth. Constructive work, however, has been started, the foundation having been laid a few years ago when the policy of appointing committees to work on certain subjects was adopted. This year these committees have been assigned definite work in which they were to construct forms, methods and specifications to be adopted and recommended by the Association for publication in a MANUAL OF RECOMMENDED PRACTICE. I have reason to believe that these committees, at least most of them, have worked hard

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upon this task, and that they have prepared for this meeting methods, processes and specifications which, if adopted and recommended by this Association, will do more toward standardizing these methods and processes and doing away with many of the difficulties of the industry than anything that has ever been done by this Association in the past.

In September, 1916, a meeting of representatives of practically every industry in the United States interested in wood preservation was held in Brooklyn, N. Y., for the purpose of considering standard methods and specifications. Representatives from the following Associations were present: American Wood-Preservers' Association, American Society for Municipal Improvements, American Society for Testing Materials, American Society of Civil Engineers, American Railway Engineering Association and Southern Pine Association, and the representatives of these associations, after carefully considering the work of our committees, agreed to recommend to their organizations for adoption, with slight modifications, the reports prepared by our committees as you will have them presented to you here at this meeting. Some of these associations have already met and adopted these reports. This should cause every member of our Association to feel proud of our organization and the work we are doing. Furthermore, this should cause us to give greater consideration to the reports of our committees as they will be presented to us, for we all know how vital it is to arrive at some standard and have it adopted in our industry.

While we want the fullest consideration given to each one of our committee's reports and the very best methods and specifications worked out before their adoption by this Association, I hope our members at this meeting will give due consideration to the fact that our committees were chosen with the idea of having in them the very best talent our Association affords for each particular line of work, and that these men have given a year of hard study and thought in the preparation of these reports. Therefore, any changes which may be suggested should be given mature consideration and if possible receive the approval of the committeemen who have the work in charge. I would also like to call your attention to the fact that instructions were given our various committees to prepare and recommend to the Association plans and specifications to be adopted by the Association and published in a MANUAL OF RECOMMENDED PRACTICE, which we expect to publish after the adoption of these reports at this meeting. This places a responsibility upon the members gathered here at this meeting, which is perhaps greater than that resting upon any meeting in the past, and I hope you will accept this responsibility and give to the Association your loyal and very best efforts in performing this work.

In the organization of our committees and work for this year it was decided to divide the Executive Committee into two branches,

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one branch having charge of the financial and business end of the work and the other branch put in charge of our publications, our program and all educational work. This plan has worked out successfully. In the Secretary-Treasurer's report you will have placed before you the status of the business end of the Association. The program which will be presented at this meeting will give you an idea of the work of the educational branch of the Executive Committee. Each one of you has received during the year our magazine known as WOOD-PRESERVING, and can judge for yourselves the advancement made in this publication.

Because of the obscurity and difficulty in finding information contained in our ANNUAL PROCEEDINGS, and because of our slowness in starting a MANUAL OF RECOMMENDED PRACTICE, it was thought best this year to prepare and publish some ready available information under the title of HANDBOOK, to serve the needs of the industry. This has been done and the volume has recently been placed in your hands. The material contained in this HANDBOOK is merely the history of the industry and ready information concerning present practices, which may serve the industry until we have a book of recommended practices with the stamp of approval of the Association placed upon it, which, of course, will require years to prepare. This HANDBOOK was published with the idea that it would be revised and added to periodically. This one is only a start. However, we hope that it meets with your approval.

If you will kindly consider the work of the Association this year in the advancement made in our publications, and in the work of the various committees, which will result in the publication of the MANUAL; the recognition accorded us by other associations, tending toward the adoption of standards in our industry; the constructive work which has been done; the harmony and good spirit which has prevailed; all of which tend toward placing our Association upon a higher plane; I believe that we have cause for much encouragement and a feeling of pride and confidence in this organization.

In conclusion I would like to direct your attention to the work of your Executive Committee which you placed in charge at your last annual meeting. To my knowledge there has not been one word of dissension among the members of the Committee this year. Each man seemed to see his duty and did it, and if I had the time to point out the work done by each member I am sure in most instances it would solicit your hearty applause. They have supported your leader in every instance and have cooperated in a way that has been highly gratifying. I say this because it was you who placed them in their present position and should know something of the work they have performed. Neither your President nor the Executive Committee has accomplished all that they set out to accomplish this year, but we hope that sufficient

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work has been done to solicit from you some praise, but better yet to have inspired in you a higher regard for your Association and help you promote the unity and loyalty necessary to keep this Association climbing rapidly on the path upward. Gentlemen, I thank you (applause).

THE PRESIDENT: Right here we wish to slightly change the order of the program for this forenoon. We are very glad to have the ladies with us, and the rest of the forenoon's program may be somewhat dull to them, in view of the fact that it is more or less of a business nature. Before they leave I want the Chairman of the Entertainment Committee to come forward and make his report, in order that the ladies may hear and know what entertainment has been provided for this meeting. Mr. Eppinger.

MR. J. I. EPPINGER: Ladies and Gentlemen and Mr. President: I have very little to say, as the Committee at its last meeting requested that the less said the better. They thought we would better put everything in print, and then there would be no misunderstanding. Therefore, there has been printed a program to which I call your attention, and would ask the ladies, especially, to watch the time mentioned on the program for meeting, as it is most essential that the busses start early that they may complete the trips laid out. Therefore ladies, we request that you be kind enough to be at the entrance at 45th Street at the times named.

Ladies and gentlemen, this evening there is to be a theater party, and tickets may be had on application to the Secretary. Tomorrow evening the banquet, and, by the way, although it is named banquet—banquet does not mean that you are to come in dress clothes. Any gentleman appearing in glad rags will be properly taken care of (laughter); if he needs the rags to go home with he is liable to go without them. Therefore, gentlemen, please take notice. It is also requested that the gentlemen requiring tickets for the banquet tomorrow please make application early that the necessary arrangements can be made. At the banquet, we are pleased to state, there is somewhat of a surprise in store for the gentlemen attending. The Committee trusts that you will all have a good time and hopes that in the near future you will be with us again (applause).

THE PRESIDENT: We will now have the Secretary-Treasurer's report.

ANNUAL REPORT OF THE SECRETARY-TREASURER.

To the Members of the American Wood-Preservers' Association:

GENTLEMEN: Your Secretary-Treasurer begs to submit herewith his Annual Report for the year 1916:

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Cash on hand December 31, 1915		$766.40

RECEIPTS.

Initiation fees	$389.95	
Membership dues	2,598.66	
Advertising—Proceedings	911.33	
Advertising—Wood-Preserving	833.53	
Subscriptions—Wood-Preserving	183.00	
Sale of Proceedings	187.38	
Sale of Handbook on Wood Preservation	71.75	
Interest on bank deposits	34.25	
		5,209.85
Total cash balance and receipts		$5,976.25

DISBURSEMENTS.

Reporting and printing 1916 Proceedings	$2,580.04	
Postage, express and telegrams	316.16	
Office supplies, stationery, printing, clerical and stenographic work	919.19	
Expenses incurred at 1916 Meeting	237.35	
Printing invitations, programs and badges	113.39	
Subscriptions to periodicals	5.00	
Expenses of Committees	35.07	
Refund for initiation fee	10.00	
Refund for Proceedings	3.50	
Membership in Chamber of Commerce of U. S. A. and National Conservation Congress	16.00	
Expenses of Wood-Preserving	1,325.58	
		5,561.28
Cash on hand December 31, 1916		$414.97

"WOOD-PRESERVING"

(For the Calendar Year 1916).

RECEIPTS.

Subscriptions	$183.00	
Advertising paid in 1915	142.32	
Advertising paid in 1916	578.47	
Advertising (1916) outstanding	353.78	
		$1,257.57

DISBURSEMENTS.

Printing (four issues)	$904.74	
Salaries, Editor and Stenographer	301.60	
Postage	50.28	
Stationery and supplies	68.96	
		1,325.58
Deficit		$68.01

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Membership.

Last annual report			276
Elected during 1916		41	
Resigned	12		
Dropped for non-payment of dues	6		
	—	18	
Total net gain			23
Membership December 31, 1916			299
Corporate	234	or	78.2%
Associate	51	or	17.1%
Probate	9	or	3.0%
Honorary	5	or	1.7%
Total	299		100%

Growth of Membership.

Year.	New Members.	Withdrew.	Added to Roll.	Total.
1904	20	..	20	20
1905	7	..	7	27
1906	9	7	2	29
1907	15	..	15	44
1908	5	4	1	45
1909	13	12	1	46
1910	29	8	21	67
1911	45	8	37	104
1912	59	6	53	157
1913	37	11	26	183
1914	92	10	82	265
1915	29	18	11	276
1916	41	18	23	299
Total	401	102	299	
Average for 13 years	30.8	8	23	

Distribution of Members.

		Members
37	Railroads	79
1	Navigation company	1
46	Commercial treating plants	99
16	Tie and lumber companies	17
24	Chemical and manufacturing companies	38
2	National Governments	7
4	Educational institutions	6
7	Municipalities	8
2	Periodicals	2
4	Associations	7
6	Firms not classified	8
	Consulting engineers, chemists, etc	27

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Geographical Distribution.

STATE	1914.	1915.	1916.
Alabama	4	3	3
Arkansas	5	4	3
California	5	6	6
Colorado	3	2	2
Connecticut	1	1	1
District of Columbia	4	4	4
Florida	4	3	3
Georgia	2	5	5
Illinois	35	41	41
Indiana	6	8	10
Iowa	2	1	1
Kansas	4	4	4
Kentucky	7	8	8
Louisiana	10	12	13
Maryland	5	5	7
Massachusetts	2	3	3
Michigan	2	3	5
Minnesota	9	10	12
Mississippi	3	3	3
Missouri	12	12	15
New Jersey	7	6	7
New Mexico	3	3	3
New York	21	24	28
North Carolina	..	1	..
Ohio	11	12	12
Oregon	7	5	5
Pennsylvania	14	12	12
Tennessee	3	2	2
Texas	17	13	14
Virginia	3	3	4
Washington	16	17	18
Wisconsin	8	9	12
Wyoming	3	3	2
	240	251	272
COUNTRY.			
Austria	1	1	1
Canada	14	13	14
England	4	4	5
Germany	6	6	6
India	1	1	1
	265	276	299

It is worthy of remark that the increase in the membership has been due in a measure to our campaign of publicity, especially through our publications—the ANNUAL PROCEEDINGS, the quarterly magazine WOOD-PRESERVING, and the HANDBOOK ON WOOD PRESERVATION—which are creating greater interest in the wood-preserving industry.

A word of commendation should be said for those members who, though engaged in the world-war, have shown their loyalty by remitting their dues in order to maintain their good standing in this Association.

Respectfully submitted,

(Signed) F. J. ANGIER,
Secretary-Treasurer.

MR. V. K. HENDRICKS: Your Committee appointed to audit the Treasurer's accounts has carefully checked same and finds the accounts to be correct. (V. K. Hendricks, Chairman, and J. H. Waterman.)

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THE PRESIDENT: Gentlemen, you have heard the Secretary-Treasurer's report. What do you wish to do with it?

MR. E. H. BOWSER: I move its adoption.

MR. W. F. GOLTRA: I second the motion.

THE PRESIDENT: It has been moved and seconded that the Secretary-Treasurer's report be accepted. All those in favor signify it by saying "aye"; contrary, "no." The motion is carried.

THE PRESIDENT: I now wish to appoint our Resolutions Committee and I will appoint on that Committee Mr. William A. Fisher, Mr. C. M. Taylor and Mr. F. D. Mattos. I will appoint as election tellers, Mr. S. D. Cooper, Mr. W. C. Mills, Mr. L. B. Shipley, Mr. George Lembcke and Mr. H. I. Goldstein.

I wish to announce that you have the privilege of voting until noon today. All those who have not voted on officers for next year will please do so before that time. At noon the time for voting closes and the sealed ballots will be given over to the election tellers. They will make their report on Thursday.

The Secretary will make any further announcements that should be made at this time.

SECRETARY ANGIER: We have but one announcement; members of Committee No. 1 on Preservatives are requested to meet in Room M at 3 o'clock this afternoon.

THE PRESIDENT: Has anyone any other announcement to make that is of interest to the Association?

Gentlemen, we have decided to change the order of the program with reference to choosing the meeting place for our annual meeting. It has frequently happened in the past that when this was left to the last day and the last order of business that a great many of the members got away and we did not have a very representative audience to vote on this, and we think it is of sufficient importance that every member vote. Therefore, we have decided to have this occur on Wednesday before adjournment at noon. You will please bear this in mind. Of course, you understand that by our Constitution only Corporate Members are allowed to vote.

MR. W. H. GRADY: Mr. President, it seems that some of the members either lost their ballot or have not received any. Does the Constitution permit more than one ballot being issued?

SECRETARY ANGIER: You can get another one by applying at the Secretary's office before noon today.

THE PRESIDENT: The Secretary has some communications which he will now read.

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SECRETARY ANGIER: These are invitations from various cities to hold our 1918 meeting, and we vote on this, as the President said, tomorrow noon just before adjournment. St. Louis sends a very cordial invitation from the Mayor, the Merchants' Exchange and the Associated Retailers. We also have invitations from San Francisco; Asheville, N. C.; Buffalo, N. Y.; New Haven, Conn.; Asbury Park, N. J.; Providence, R. I.; and Chicago.

MR. NELSON C. BROWN: Mr. President, on behalf of the Mayor and Chamber of Commerce of Syracuse, N. Y., I extend a very cordial invitation to this Association to hold its next annual meeting at Syracuse. I want to add that invitation to the already long list of invitations. I could extol at some length upon the beauties and attractiveness of the hills and dales of Onandaga County and surroundings, but suffice it to say that we have all the advantages of Chicago and a few more. I thank you (applause.)

MR. V. H. ROEHRICK: Mr. President, in behalf of the City Council of the City of St. Paul, I would like to tell you that the last Saturday in January is the time of our famous Winter Sports Carnival, and if you have the next convention in St. Paul you will be there in time to take that in. It is well worth seeing. It far exceeds the Mardi Gras at New Orleans. If you can get up there next year the week before the last Saturday in January, why I am sure you will have a very enjoyable time.

SECRETARY ANGIER: Mr. President, I thought someone would mention New Orleans (applause.) I received a letter from Mr. Manley this morning, of which I will read a portion because some of it is confidential. He says:

> "I have started something which I cannot finish, that is, I proposed to all the members of the American Wood-Preservers' Association by circular letter, as you know, that they hold their next convention in New Orleans, and now at the last minute I find that it is absolutely impossible for me to leave New Orleans at this time to attend the convention of the American Wood-Preservers' Association. I have sent Mr. F. P. Hamilton, a representative of the Creosoted Materials Company, to the New York Convention, for the purpose of representing me there in the interests of New Orleans as the next convention city, and also to represent me in such matters concerning wood block specifications and so forth which may come up. I trust that if entirely consistent you will express my regret to the convention and state that Mr. Hamilton is representing me there in the interest of New Orleans, and further from that I should like very much to know that you will render him your active support."

MR. F. P. HAMILTON: Mr. Secretary, I thought we would hear from New Orleans before you got through. Most of you have been there. You know what New Orleans is. We have got more to offer to you than all these other places combined (laughter.) We hope to get your vote tomorrow.

THE PRESIDENT: Gentlemen, there seems to be no doubt but that we will have a place to meet next year. This ends our program for this morning. We are getting through a little early, but it

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will give you an opportunity to register, and those of you who have not voted to do so, and also to get your lunch and be back here on time. May I not urge all of you to make an effort to be at our meeting place here at the appointed time for each meeting? This is very necessary. It lends encouragement to the Association and gives those in charge of the work encouragement and help. Therefore, let me urge upon you to make an effort to be here promptly at 2 o'clock this afternoon, and at the same hour on succeeding days in the afternoon, and at 10 o'clock in the morning.

An adjournment was then taken till 2 o'clock P. M.

TUESDAY AFTERNOON SESSION.

January 23.

The meeting was called to order by President Crawford at 2 o'clock P. M.

THE PRESIDENT: We will now have the report of the Committee on Publicity, Promotion and Education, and I will ask the Secretary to read the names of this Committee, and as he reads them to have them come forward and take the chairs on the rostrum.

SERETARY ANGIER: Mr. E. A. Sterling, (Chairman), Mr. John S. Bates, Mr. Nelson C. Brown, Mr. F. P. Hamilton, Mr. E. T. Howson, Mr. S. J. Record, Mr. P. S. Ridsdale, Mr. C. C. Schnatterbeck, Mr. O. T. Swan.

MR. E. A. STERLING: Mr. President and Gentlemen: This report is very short and summarized in definite paragraphs, so I will read the whole thing.

REPORT OF COMMITTEE ON PUBLICITY, PROMOTION AND EDUCATION.

To the Members of the American Wood-Preservers' Association:

The work assigned to Committee No. 7 falls under four distinct headings according to the instructions of the Executive Committee. Summarizing these as subject or chapter headings, we have: (1) Current Publicity, (2) Cooperation, (3) Educational Promotion, (4) Recommendations for future work.

Recommendations and procedure under the above headings as outlined are suggested as follows:

1. **Current Publicity.**

   (*a*) That every member of the American Wood-Preservers' Association constitute himself a committee of one to talk and advocate the proper use of treated material wherever consistent with the requirements of the situation.

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(*b*) That individuals and companies furnish to their local newspaper interesting facts and information about the use of treated wood, this to include preliminary arrangements with the editors by pointing out the value and importance of the use of treated material in community development and permanence of structures. Then furnish interested editors with news items on new work, orders and inquiries for treated material, wood-block paving, and similar subjects.

(*c*) That more extensive advertising of treated timber is necessary and advisable, and that at comparatively small expense commercial wood-preserving companies, individually or as a group, could advertise in local newspapers.

(*d*) That commercial wood-preserving companies in or near universities or college towns arrange trips of inspection through their plants by the engineering students. Arrangements should be made as soon as possible, so that the inspection can be made during the pleasant autumn months.

(*e*) That the secretary of the Association circularize the members to ascertain those who will volunteer to give talks on wood preservation at nearby colleges and universities, and having obtained this list of volunteers work out a schedule and arrange with the schools for these talks and lectures, with stereopticon views and moving picture films if possible.

(*f*) That the attention of commercial wood-preserving companies be called to the possible development of treated highway bridges, and that they individually promote this use of treated wood by general publicity, and by propaganda among highway engineers and county highway commissioners.

(*g*) That the members of the American Wood-Preservers' be frequently and emphatically reminded of their obligations in furthering the interests of the industry.

(*h*) Adopt a slogan and give it publicity.

(*i*) Brand treated timber and advertise it.

2. Cooperation.

(*a*) That the officers and members of engineering and professional organizations, such as the American Society for Testing Materials, Amercian Railway Engineering Association, National Electric Light Association, and others, be furnished periodically with information about the work of the American Wood-Preservers' Association, and on the general subject of proper use of treated material, this information to take the form of brief, concise leaflets, and include solicitations for subscriptions to WOOD-PRESERVING.

(*b*) That a list be made up of enginering, professional and trade organization meetings during the fall and winter, and arrangements made for talks or addresses on some

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phase of wood preservation at these meetings, the members of the Association to volunteer to give these talks at the request of the secretary.

(*c*) That the many lumber associations, both manufacturers and retail, be kept informed of developments in wood preservation, the same as engineering and professional organizations, and that through the secretaries of these associations the members be solicited to subscribe to WOOD-PRESERVING.

(*d*) That a basis of cooperation be established with city engineers and highway commissioners to aid in promoting wood block.

(*e*) As a more definite form of cooperation in "Current Publicity" it is suggested that the American Wood-Preservers' Association cooperate with the National Lumber Manufacturers' Association especially along the lines of publicity in newspapers, engineering journals and lumber trade papers, on developments in wood preservation. The National Lumber Manufacturers' Association has a well organized news service, and will take rough news items, facts or information of any kind, put them into proper shape, and send them out with its regular news service which goes to over 5,000 newspapers and to practically all of the trade and professional journals.

(*f*) The Monthly Bulletin of the National Lumber Manufacturers' Association will carry one or two columns of wood-preserving news regularly if supplied by the American Wood-Preservers' Association in usable form.

3. Educational Promotion.

(*a*) As a broad educational propaganda the architect and engineer should be reached with information on wood preservation. Much of the information now available does not reach professional men who specify material, and when it does it is frequently not in the form which they can readily use.

(*b*) Over-lapping to some extent on the subjects above is the general education of retail lumber dealers on the use and possibilities of treated wood, they in turn being the important medium of education to the smaller consumer.

(*c*) Preparation and publication of articles on wood preservation in technical journals should be included in the broad educational work.

(*d*) Another educational feature, which is included in the above under "Current Publicity," because it should be carried on as a current project, is the lectures for the engineering students, and the trips of inspection through wood-preserving plants. A special course in wood preservation should be recommended at colleges and made a permanent educational feature.

4. Recommendations For Future Work.

(*a*) The future work of the Committee should consist largely in developing and carrying out the lines of

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publicity and educational activity which prove to be feasible and possible by a voluntary committee under an association which is handicapped by lack of funds. Experience will also determine the practicability of promotion effort by an association which is composed in part of non-commercial interests. The increased sale and use of the material which the organization represents, and greater knowledge of methods and results will follow from systematic publicity.

While the commercial plants are primarily interested in a general increase in the use of treated timber as a means of increasing output and sales, the managers of railroad plants also need the assistance of the Association in carrying to all railroad officials the necessity and advantages of extending the use of treated timber by railroads to all places where such use is consistent with the service required. It follows, therefore, that publicity and education are of value to all classes of members in the Association. The ends to be attained are the same, although the reasons for attaining them are radically different.

E. A. STERLING, *Chairman*
JOHN S. BATES
NELSON C. BROWN
F. P. HAMILTON
E. T. HOWSON
SAMUEL J. RECORD
P. S. RIDSDALE
CHAS. C. SCHNATTERBECK
O. T. SWAN

MR. E. A. STERLING: Gentlemen, Paragraph "b" (page 50) covers a phase of our work that has been sadly neglected. The plants are all operating in or near community centers, towns and cities of various sizes. It is evident in any clipping service that wood preservation gets into the public press very rarely, yet you have very many interesting things going on which the editors would be glad to print. It is suggested here that you get acquainted with the editors and make arrangements in advance. This will be helpful, but perhaps not absolutely necessary. The most important phase of this, I think, gentlemen, is to give the papers real news, and under no circumstances attempt to put over something in the way of free publicity, because you will hurt your own game and you will not get it. There are some things in the way of actual newspaper news which they will be glad to use.

Paragraph "c" (page 50): The possibilities of local advertising have not been developed, and that perhaps to some extent at least ties up with the news service which you would get. Strictly speaking, there is no connection between advertising and news service, but since editors, wood-preservers and everybody else are human, personal contact and

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acquaintanceship go a long way It would be easier to get editorial comment and easier to get newspaper matter printed if the industry advertised locally and nationally, which it should do.

Paragraph "d" (page 50): This is a line which I understand has been developed to some extent through your Secretary, but no doubt could be carried a great deal farther. The average architect and engineer graduating from a university has little or no knowledge of wood preservation. He may hear an occasional lecture but one of the strongest educational factors would be for him to see with his own eyes how timber is treated, what it looks like, and talk to the men in charge of the plant.

Paragraph "e" (page 50): This could tie up very nicely with the preceding one. The talks would be a good introduction to trips of inspection, and arrangements could probably be made at the time with the man who gave the talk for an inspection trip through some nearby plant. There are a great many men in this audience, and as members of the Association, who can give interesting talks on the industry they represent, and it will be a very small thing for every man to give one, two or more days to talks of this kind. It would do them good and it would certainly do the students a great deal of good and help the industry. The stereopticon views and moving picture films I think are mentioned later on, but there are slides and films now available. Some of the railroads have moving picture films of their own plants. The Forest Service has various educational material of this kind, and it would be very easy, I think, for the Secretary or for the Association to obtain for permanent use a set of these slides and films.

Paragraph "f" (page 50): The question of highway bridges was brought up because it is a subject which has come to the fore during the last year or two. There is also some difference of opinion as to what the individual treating company managers do in promoting this. The natural assumption was that the local men have a local influence with their commissioners. At the same time that gets you into the realm of city or county politics which is not always a good thing to mix up in. However, we know that highway bridges generally are being built of materials other than creosoted wood. We also know at the same time that a creosoted highway bridge, properly designed and properly treated, is very good and very permanent, and it seems to me that this is an overlooked opportunity.

Paragraph "g" (page 50): This would be a sort of a followup proposition to keep us all reminded continually of what we might do to help ourselves and the business.

Paragraph "h" (page 50): It is just plain, everyday advertising sense, to have a slogan and to play it up before the people.

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Cooperation (page 50): That would be very lovely, and I hope it may happen sometime, but I am afraid you are not ready to talk details on it.

Paragraph "a" (page 50): In other words, this is just a matter of cooperation between the American Wood-Preservers' Association as one national body and other national bodies which are, generally speaking, consumers or potential consumers of treated material.

Paragraph "b" (page 50): In other words, we have occurring, as you know, now and for the next two or three months, and in fact back for some time, a great many meetings, technical, semi-technical, trade, professional and otherwise, and it is only by accident that the subject of wood preservation is presented It would be a big task to cover the whole field, it would probably require an organization somewhat different than this, but at the same time we have here an opportunity under proper guidance for the members to get out and talk at these various meetings.

Paragraph "c" (page 51): That is simply a specific phase of the subject which is covered under "b," and I might say incidentally that the lumber associations would be especially glad and especially interested to have more information on this subject. There have been a number of requests during the past two or three months for this very sort of thing coming to our Association, particularly from organizations and retail lumber dealers. They are not handling treated material to any extent. They know there is such a thing. They would like to know more about it, and if the men were only available either from this Association or elsewhere, we could put before the retailers of the whole country the essential facts of the subject.

Educational Promotion (page 51): I want to say about those two subjects that all of you ought to be ashamed of yourselves. I do not think what I am going to say will do much good, because it has been said before and will probably have to be said a great many times again. Each one of you handles over his desk and in his mail and in his every day business, facts and information which would make excellent publicity, around which and upon which good stories could be written for many classes of publications, and yet you sit and let those things go into your files or somewhere else, and they never get to your Secretary, they never get to the publicity organization you maintain as part of the Association, and they certainly do not get to the newspapers.

You are missing a very great opportunity. It goes without saying that you are not newspaper men and do not pretend to be, but you do not have to be. If you will shoot this information in, as a memorandum or in any form, rough as it may be, it can be whipped into shape by

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newspaper men and used. Why do you not do it? Probably first because you think of it today and you do not think of it again until somebody reminds you, and perhaps another reason is—and I hate to say this too—that wood-preservers, like men in a great many other lines, are afraid particularly of the other fellow.

You have an idea that you are going to give something away. You do not know just what harm it is going to do, yet you think it might do some harm, but I want to tell you publicity is the order of the day.

If you have any items on business, any items of paving or items on bridge work, or a hundred and one other things, do not be afraid that your competitor will get hold of them. Supposing he does? It is going to help the whole game along. You cannot do any better than to start sending in to your Secretary all sorts of information of this kind that you get. You have among other things, the offer from our organization to devote some space in their Bulletin to this subject if you will only send us the material.

Paragraph "a" (page 51): A lot could be said about that. I am going to touch on one phase of it. For many reasons architects are advocating more mill construction buildings this year, and will plan more in the future than have been put up for a great many years. There is a wave of enthusiasm for mill construction going all over the country in connection with this cooperative movement, the character, kinds and grades of lumber to use, the question of its durability. There are a number of cases of failure of roofs, and when the architects come to consider these things how many of them think or know anything about wood preservation as a partial solution. That is the trouble. Hardly any of them know. A man may know a little something about it, but he is handicapped everywhere because the treating plants themselves do not help him any, there is no definite information on the subject, and he simply throws up his hands and gives it up as a bad job. There is a distinct commercial opportunity for developing the use of treated material which everyone of you should follow up.

Paragraph "b" (page 51): I touched on that in the heading farther back. There are a great many of these dealers who are interested in this. They would like to know more about it. They would like to handle treated material, if it were made possible for them to do so.

Paragraph "c" (page 51): That is a little different than the short news items which would probably have to be rewritten. All of you take your pen in hand once in a while and perpetrate something for WOOD-PRESERVING or in the PROCEEDINGS or in a report, but you could do a whole lot more. I am sure that the professional journals

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would be very glad to publish it. Incidentally, do you ever pick up an engineering journal and note the beautiful absence of anything about wood preservation? You who are running commercial plants will find your competitors are distinctly on the job. You will find their names on all the headlines, but you do not find very much about the use of treated material.

Recommendations for future work: In other words, this is mentioned under the two headings, because it is something that should be done as a current project and at the same time it is broadly educational.

(Mr. Sterling then concluded the reading of the report.)

MR. E. A. STERLING: That last paragraph brings up an apparent difficulty, and yet not necessarily an insurmountable one if handled rightly. I think I might add to what is said there that the railroads have almost as direct an interest in the general promotion of the use of treated material as the commercial plants, because it comes back to them through their Traffic Department, and through the possibility of greater tonnage. It is also one of the broadly educational things which tend to build up industries along their line, and you can start from the farmers with their treated fence posts right up through to the shipments of large material for large structures.

I will close by mentioning one point which I am afraid our Committee overlooked, and that is the possibility of developments in the educational propaganda through the Industrial Departments of railroads. Some of the railroads I understand already have moving picture films of their treating plants, most of them certainly have very live Industrial Departments interested in all phases of work of this kind, and it would seem a very easy thing to give those industrial departments the necessary information on which to spread the propaganda of wood preservation. I thank you (applause.)

THE PRESIDENT: Gentlemen, this Committee has outlined a plan that will do much towards building up and strengthening our Association. The same Committee, or a Committee under the same heading will be in force next year. I think it will be quite proper to devote this time to comments or criticisms whichever they may be, that will help this Committee in presenting a final report satisfactory to this Association. It is now in your hands.

MR. WALTER BUEHLER: I wonder if anyone here appreciates the real value of the suggestions made by this Committee. I want to give you a concrete example of the necessity of publicity, and this example may probably be a surprise to some of you.

I attended a meeting some time ago where they were discussing the relative value of timber versus concrete docks. Someone brought

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up the question of creosoting the timber in the timber docks. The chief engineer of a certain railroad was present and was expressing his opinion as to the relative life of concrete and timber docks. He said that a timber dock will have a life of from 12 to 15 years, and under certain conditions 8 to 10 years. The question was asked him, "If you treated the timber how much longer would the dock last?" He replied, "Oh, probably 2 or 3 years longer." That comes from the chief engineer of a railroad, and I claim when the chief engineer of a railroad displays this ignorance of the subject it is time for this Association to begin education along these lines. I therefore, want to make this motion that this Committee be thanked by the Association for its valuable suggestions and recommendations, and further that the Executive Committee be instructed to work out some practical plan whereby the Association may derive benefit from the recommendations and suggestions of this Committee.

MR. J. H. WATERMAN: I want to second that motion, and I want to speak to it just a minute. I do not know of any men that need education along the line of treated material any more than the railroad men of this country. That is a pretty broad statement, but I am here to back it up.

I know a man who is quite an enthusiastic treating man, and he received a letter from the vice-president of his railroad stating this: "I am glad you are enthusiastic, because I hope that through your enthusiasm more information will reach the officers of the railroad which you represent." I tell you they do not know very much about treated timber. The only way you can get it in their heads or get them to grasp it is to talk about it in season and out of season and all the time.

Another point I want to make is the question of treating posts. In the past three months at least half a dozen men have come to me in our town and have said, "How can we treat posts"? showing the public was wide awake. One was a farmer, I think two of them in fact, one was a banker, and the other man was a butcher. So you see they are all interested, if we can get the news or the facts to them.

THE PRESIDENT: Gentlemen, there has been a motion made and seconded. We will not vote upon this motion until you have had an opportunity to offer whatever comments or criticisms you may have to offer on this subject along with the discussion of this motion, if this is satisfactory.

MR. E. T. HOWSON: Mr. President, I would like to refer to this subject from a little different angle than most of the men in this Association see it, being more directly connected with the editorial side of the problem.

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Last spring when we saw that the price of steel was rising very materially, I wrote five or six members of this Association, to endeavor to secure discussions from them of the opportunities for mill construction for certain types of railroad buildings. We could not get the information from the men who had it so we were unable to give that subject any publicity.

Hardly a week goes by but what I receive the inquiry, "Can you use an article? We have located something interesting on concrete." I happen to be in the same city where the headquarters of the Concrete Association are. These manufacturers have an organization to put that information out. They advertise "Concrete for Permanence." They have a library of several thousand volumes and anybody who wants any information on that subject can get it from them in a minute. They have brought about co-operation between the manufacturers and that is the reason they are making inroads on timber.

The timber industry has an opportunity now that it has not had in recent years, yet we in the editorial line find it almost impossible to get information on timber. We do not get the co-operation of the men in the field who run across the interesting features. If we go out we can get them through our good friends in the timber field—but we do not have time to do all these things. The other folks bring the data to us. You will find no one in the editorial field, I am sure, asking for that information in order to fill their papers for they have more material than they can use. It is a process of selection, but at the same time they desire to maintain a balance in their papers. Those who are friendly to timber want information concerning it, but they cannot secure it alone. We have got to have the co-operaton of the men who have first-hand information and access to the facts. The opportunity is there. The extent to which it will be utilized depends on the extent to which the men of this Association co-operate.

MR. E. A. STERLING: Supplementing what Mr. Howson said, we checked up the material in a Christmas issue of one of the larger, if not the largest, engineering journals. We found eleven and a fraction column-inches relative to wood, that was both treated and untreated, and in the same issue there were 274 column-inches of competitive materials. That bears out what you say.

MR. F. J. ANGIER: Mr. President, for several years past we have, in co-operation with the Forest Service at Washington, compiled a report and printed in the PROCEEDINGS, which has been very instructive and interesting and a report that has been looked forward to by a majority of our members and others interested. I refer to the report entitled "Quantity of Wood Preservatives Consumed and Amount of Wood Treated by Wood-Preserving Plants in the United States."

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This report gives a summary of the wood-preserving plants, the consumption of preservatives, the progress of wood preservation in the United States and other valuable information. It also contains a comparative statement of the material treated in the United States showing the number of cubic feet of cross ties, piles, poles, paving blocks and other material and amount treated with creosote, zinc-chloride, zinc-creosote and other preservatives.

We have been quite fortunate in getting this information from a majority of the plants, but there are a few that for one reason or another withhold this information. To all such we have endeavored to assure them that the detailed information pertaining to their particular plant will in no way be divulged; that it will be treated strictly confidential. As the report shows, we simply print the totals of all plants showing the number of cubic feet of material treated and quantity of preservatives used. The individual reports are held under lock and key and no person outside of the one who gives the information is allowed to see it.

I hope with this explanation that all of our members and others who may be called upon to furnish this information will not hesitate to furnish it. Last year, I believe, the information was furnished from every plant but three, and one of these has just assured me they will furnish it, and I sincerely hope the others will do likewise.

THE PRESIDENT: Are there any further comments? Gentlemen, I feel that every person that has the good of the wood-preserving industry and this Association at heart—for in my opinion you cannot have the one without the other—should take a deep interest in this Committee's report, and should individually bend his best efforts in helping to put this Committee's recommendations into effect. If there are no further comments or discussions we will put the question still before the house.

MR. M. K. TRUMBULL: Mr. President, Mr. Kendrick stated before the Association at the annual meeting last year that the railroads of this country would be able to save from eighty to one hundred million dollars per annum by treating all their ties. This was exclusive of all other classes of forest products. As far as I have been able to observe this statement received no more publicity than its utterance at the annual meeting, and its publication in the PROCEEDINGS. It occurs to me that such an item is well worth dissemination and directly in line with the report of the Committee.

THE PRESIDENT: All those in favor of the question signify it by saying "aye"; contrary, "no." The motion is carried.

The Chairman of the Committee on Service Tests of Ties and Structural Timber is not here. He has forwarded by express a part

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of the material belonging to the report, but it has not reached here. Consequently we will have to defer this report until tomorrow. Therefore, we will pass on to the report of the Committee on Terminology, and I will ask the Secretary to read the names of this Committee, and they will please come forward as the names are read.

SECRETARY ANGIER: Mr. J. B. Card, Chairman, Mr. E. T. Howson, Mr. Geo. M. Hunt, Mr. G. B. Shipley, Mr. M. K. Trumbull.

MR. J. B. CARD: Gentlemen, I hardly think that we will have the time to take up every part of this report this afternoon. Therefore, we have decided to pass over some of it and take up the more important parts of the report first. If you will turn to page 76 you will see the heading, "Principal Processes used in United States." We are anxious to agree on a description of these processes in order to have them ready for the MANUAL at the earliest possible moment. Therefore, we will begin here. The first one under this heading is the Allardyce process, a description of which I will read.

We wish to take action on the description of these different methods of treatment, one at a time, so if any of you have any criticisms of these different descriptions we would be glad to hear the remarks at this time.

THE PRESIDENT: Gentlemen, you will understand that these terms and definitions have been prepared with the idea of having them adopted by the Association, and perhaps later published in the MANUAL.

MR. J. H. WATERMAN: What do you want, a motion to accept that paragraph?

THE PRESIDENT: Yes.

MR. J. H. WATERMAN: I move that the paragraph read by the Chairman of the Committee be accepted and adopted by the Association.

MR. WALTER BUEHLER: I second the motion.

THE PRESIDENT: It has been moved and seconded that the description of this process be accepted and adopted by this Association.

MR. A. R. JOYCE: Mr. President, this is a description of various methods of preserving timber. The last sentence reads: "The process is not in extensive use at present." It has nothing to do with the description of this particular method of treating timber. Do you not think it ought to be omitted? It is a comment. I would like to amend Mr. Waterman's motion that this description be adopted with the exception of that last sentence.

MR. J. C. WILLIAMS: I second the amendment.

THE PRESIDENT: Will the Committee approve of that recommendation?

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MR. J. B. CARD: Yes.

MR. J. H. WATERMAN: You can include that in the original motion.

THE PRESIDENT: In other words, the Committee approves that, and, therefore, we need not have the motion amended.

MR. A. R. JOYCE: I will second Mr. Waterman's motion as amended then.

MR. A. L. KUEHN: Mr. Chairman, I would like to ask if this motion means that this description is the recommendation of the Association as to the manner in which this process should be used? In other words, do we put our stamp of approval on this?

MR. J. CARD: These descriptions are simply definitions. They describe the manner in which the treatment has been done in the past and is being done at the present time.

MR. A. L. KUEHN: I think we have got to be careful to have it understood that this is not the recommendation of the Association as to the exact manner in which the process shall be worked.

MR. J. B. CARD: No, that is not the idea.

MR. A. L. KUEHN: I am afraid that is what your recommendation will come to if it is put into the MANUAL. This is the approved method and has the stamp of approval of the American Wood-Preservers' Association.

MR. J. B. CARD: I will read the first paragraph and that may make it a little clearer:

> In attempting to describe the various wood-preserving processes it is recognized that the details of the procedure followed may vary at different plants using the same process. In some cases the process has gradually changed in one or more details from that described in the original patent, but still retains its name. In the following descriptions the attempt has been made to give in as few words as possible the essential details of the various processes as used at present, without attempting a rigid definition. If any errors are discovered the Committee will appreciate having same called to its attention.

MR. J. H. WATERMAN: Mr. Chairman, we have to either accept one or the other. We have either to accept this definition of the Allardyce process, or we have to move an acceptance of it as a definition, and the way to treat ties or timber with this process. Now, what are we going to do?

THE PRESIDENT: Gentlemen, as I understand this, the instructions of the Executive Committee to this Committee were to prepare terms and definitions by which such treating plant equipment, treating plant operations and treating plant processes might be known. I take it that the work of this Committee is merely that of defining equipment, parts of equipment and processes and various terms in operation and not attempting to endorse those particular processes or parts of equipments or methods.

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MR. J. H. WATERMAN: Mr. Chairman, can I change m
or withdraw it?

THE PRESIDENT: With the consent of your second

MR. J. H. WATERMAN: I would like to make my motion re
this way, that this organization accept this as the standard descrip
of this process. Then it is easy.

THE PRESIDENT: First I would like to know if the seco
will accept that change.

MR. WALTER BUEHLER: I will accept it.

MR. A. R. JOYCE: The second will accept the change with
last sentence left out?

MR. J. H. WATERMAN: They have erased the last sentence
from it figuratively. They have cut that out.

MR. WALTER BUEHLER: This report comes under the head
"Report of Committee on Terminology." In the opening paragra
instead of reading the one at the beginning of the processes, we find:

Your Committee on Terminology was instructed to present
for adoption at the annual meeting, for insertion in the MANUAL, terms
of plant equipment and operation, also description of processes used
in the United States.

I would suggest to the Chairman of the Committee and the other
members, that it might be possible to put a sentence there that will
follows is not intended to be recommended practice, but is merely
set forth as what is understood to be descriptions and definitions best
intended to cover the purpose.

MR. WM. A. CECIL: Mr. President, I think there is only one
objectionable feature, and a few words that should be cut out, and
that is the statement that the process is not in extensive use. The
process is properly described just as it is.

THE PRESIDENT: That has been cut out.

MR. WM. A. CECIL: That is all, the process is properly
described, and any process that has given good service should be left
to the people to decide whether or not they will use that process. Just
give a description and the description is the endorsement of the process,
and let it stand as an endorsement, because the process is all right and
all the processes that are used are good, everyone for the particular
purpose. So I just say that we should give the description as it should
go in the MANUAL, and that it is endorsed by this Association, provided
the user wants to use that process.

THE PRESIDENT: Are you ready for the question?

THE MEMBERS: Question, question.

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THE PRESIDENT: All those in favor of the motion as put Mr. Waterman, please signify it by saying "aye"; contrary, "no." motion is carried.

MR. L. B. MOSES: Mr. President, I would like very much to a statement put into the MANUAL in connection with these definitions different processes, stating very clearly that it either is or is not ommended practice. I do not think that it is sufficient to leave t as vague as it evidently is in the minds of many of our own mbers now, because those of us who have got to use this MANUAL soliciting the sale of treated materials will certainly have that estion put very definitely to us, and we must be in a position to nswer it yes or no. I am not clear myself, as to how I could answer at question in regard to the Allardyce process. As I understand t, that is exactly the point made by Mr. Kuehn. It has nothing to do with the point made by Mr. Cecil. A railroad might say, "We want to use the Allardyce process." Now is this definition the recommened practice of the American Wood-Preservers' Association? I do not know. I do not care whether the statement is that these terms are placed in the MANUAL as definitions and nothing more, or whether they are put in the MANUAL as definitely recommended practice, but one or the other I think should be clearly stated.

MR. WM. A. CECIL: Mr. President, I agree with that idea. I believe that anything that goes in the MANUAL should be recommended practice without any further statement, and any process that is in use or is used is recommended practice for the purpose for which it is the best. Now then when you say in your MANUAL, make a specific statement to the effect that the Association does not recommend, or it is not the recommended practice of the Association, or anything of that kind, you may retard the development of a process that would really be valuable in the future. You would be doing the man who has given his time and his work to the development of the process, or to working out the idea an injustice, you would just injure his business. That is all there is about it.

THE PRESIDENT: Gentlemen, the instructions to the Committee on Terminology were to present for adoption at this annual meeting standard names of processes, preservatives, machinery and equipment and terms of plant operation, for insertion in the MANUAL. In adopting these standard names of processes and their definitions I do not believe we are putting the Association on record as stating just how these processes shall be carried out in adopting the definition which describes the process. This, it seems to me, would answer Mr. Moses' question.

MR. EARL STIMSON: The MANUAL is to be called the MANUAL OF RECOMMENDED PRACTICE, and as such should contain only the results

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of the work of the Association—matter which has been subject of the independent study and research of the various committees and in turn approved and adopted by the Association, in the form of definitions, methods, specifications, etc. These descriptions of processes (mostly patented), do not therefore come within the scope of the MANUAL, and should be received as information only, to appear in the PROCEEDINGS as part of the Committee report and to be published (as some have already been) in the HANDBOOK, which is a book of general information only.

MR. JOHN FOLEY: Mr. Chairman, it seems to me extremely difficult to define a wood-preserving process; you have to make a description of it. As soon as you try to describe it, you practically make specifications under which to operate it. While the Committee has told how the processes should be worked, it has not fixed any very tight standard to be adhered to by saying each process "consists essentially of the following steps." Then the Committee says that the solution is forced into the wood after about so much time, at about so much temperature, to give wide ranges of absorption.

It seems to me that the American Wood-Preservers' Association, provided all the various limitations are acceptable, could consider the description as acceptable for the process in question; that is, a standard description of the process which anybody soliciting business could use, the buyer deciding whether he desired 4 lbs. or 24 lbs. per cubic foot. I feel that you must, if you put these things into the MANUAL as recommended practice, regard them as standard within the limitations of the description.

MR. L. B. MOSES: I have evidently not succeeded in making clear what I had in mind. I am not either advocating or opposing the recommendation of any process. I fully understand that it is not the thought of this Committee to make any recommendation that the Allardyce process shall be used. What I want to know is this, are we to understand if a railroad, for example, should decide to use the Allardyce process, we are, as the result of this Committee's report. authorized by this Association to say if you use the Allardyce process this is the recommended practice as to how it shall be used? I have no reason to suppose that this is not a perfectly proper thing to say to them, on the contrary, I suppose it is. I have every confidence that it is but I want that definitely stated one way or the other, not as a recommendation of process, but as a statement of this Association's recommended practice for the handling of that process if it is used, if it goes in the MANUAL that should be stated yes or no, that if the Allardyce process is used this is or is not the Association's decision as to how it should be done. That is as I understand the question Mr. Kuehn raised. It is not a question of recommending a process.

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MR. A. L. KUEHN: Mr. Chairman, there is another important point to this thing. Some of these processes are patented. Who is the one that is to furnish the description? Were these descriptions furnished by the originators or owners of the process? In fact, that is the way Mr. Moses would get his specifications.

MR. J. CARD: These descriptions, Mr Kuehn, were submitted to all parties that were interested in these different methods of treatment.

MR. A. L. KUEHN: I think that is a point that should be made clear also.

THE PRESIDENT: Gentlemen, that being the fact it seems to me it might be in order to have a motion as to how we expect to use these terms if they are put in the MANUAL.

MR. J. H. WATERMAN: Do we not want that motion after we are through, not now? Is there not a motion before the house now?

THE PRESIDENT: No.

(Mr. Card then read the description of the Bethell process. See page 76).

THE PRESIDENT: What is your pleasure, gentlemen?

MR. J. C. WILLIAMS: I move the definitions be accepted.

MR. J. H. WATERMAN: I second the motion.

THE PRESIDENT: It has been moved and seconded that this definition be accepted.

MR. GEO. M. HUNT: Mr. Chairman, there is one word I would like to say now, so that we will all understand thoroughly that these processes are not necessarily as originally patented. If you will look up Bethell's patent, No. 7731, you will find that he did not use this process at all. He used creosote entirely, but he merely soaked the timber in creosote. It was some time after this patent was granted that he began to use pressure. That is covered here in the preliminary paragraph, where it says,

> In some cases the process has gradually changed in one or more details from that described in the original patent, but still retains its name.

This definition, therefore, is meant to cover the process as it is now understood, and by accepting this definition you will give a definite meaning to the Bethell process while if this Association does not adopt it, or some other association does not adopt it, there are a number of things that might be called Bethell.

MR. K. F. STAHL: Would it not be better in paragraph "B" to substitute the word "creosote" for "oil"? While we understand that we mean creosote, I think it would be better to use the word "creosote" in place of "oil."

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MR. J. C. WILLIAMS: I disagree with the gentleman's remarks. You could inject petroleum oil by that process. You certainly could inject water-gas tar, and you cannot limit the description of the Bethell method of operation by putting in one particular type of preservative. The description is better as it is.

THE PRESIDENT: Gentlemen, if you are ready for the question, all those in favor please signify it by saying "aye"; contrary, "no." The motion is carried.

(Mr. Card then read the description under "Boiling." See page 77.)

MR. J. H. WATERMAN: I move you this be adopted.

THE PRESIDENT: Is there a second to the motion?

MR. A. H. NOYES: I second the motion.

MR. W. F. GOLTRA: I notice that most of the specifications are designated by the name of patentee or inventor, for instance, Bethell, Burnett, Rueping, Boulton, Lowry, etc. Then why not designate the boiling in oil process "Curtis and Isaacs" instead of "Boiling"? I would suggest that we head that paragraph "Curtis and Isaacs" instead of "Boiling."

MR. J. B. CARD: This method of treatment has been known as the Boiling process more than it has been known as a Curtis or an Isaacs process. It has been commonly called a method of boiling.

MR. J. H. WATERMAN: Better use the common name for it. People would understand it.

THE PRESIDENT: Are you ready for the question? All those in favor of the motion signify it by saying "aye"——

MR. F. D. MATTOS: I think that paragraph "E" should be changed to read "5 to 20 lbs. per cubic foot" as 10 to 12 lbs. per cubic foot does not cover all cases. For instance in the case of paving blocks we inject as high as 16 lbs. creosote oil per cubic foot, while in the case of piles 10 to 20 lbs. is used. The injection of 5 lbs. per cubic foot refers to when the Boiling process is used in connection with the Rueping process. I think that this change should be made in order to cover all cases.

MR. J. H. WATERMAN: Do you use the Rueping process with the Boiling process?

MR. F. D. MATTOS: Yes, sure. The Boiling process is merely the means of seasoning timber artificially.

MR. J. H. WATERMAN: What do you want that to read, from 5 to 12 pounds?

MR. F. D. MATTOS: No, from 5 to 20 pounds.

MR. GEO. M. HUNT: How would this be, Mr. Mattos? To fix it, as in the process before, "the amount of oil injected depends upon

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the specifications of the purchaser, but the absorption per cubic foot is usually within the following ranges," and then give the ranges as given now under paragraph "E." Would not that be correct?

MR. F. D. MATTOS: Yes, it could be that way, but I think it would be more satisfactory if it was clearly stated in this paragraph. Of course, a good many do not seem to understand that the Boiling process is merely the means of reducing the moisture content of timber under treatment. The amount of oil injected cuts no figure.

MR. J. C. WILLIAMS: Mr. President, it seems to me that if you amend paragraph "E," and give the same information that you do in the last four lines of paragraph "C" of the Bethell process, that you have fixed the quantities of preservatives and you have given the same ranges under one process that you have under the other.

MR. GEO. M. HUNT: Mr. Chairman, if you do that you are not describing the Boiling process, but you are describing a combination of the Boiling and some other process. It is thoroughly recognized that the Boiling can be used in combination with other processes merely to do your preliminary seasoning, by boiling in oil instead of steaming, or some other method, but we are describing here merely the Boiling process as it is usually carried out when you do not combine any other process with it. So I would like to ask Mr. Mattos if in the straight Boiling process this "usually 10 or 12 lbs. per cubic foot" is not correct? Not combined with any other process?

MR. F. D. MATTOS: It is correct as far as the treatment of structural timber is concerned, but in the case of piles and paving blocks a much heavier treatment is given.

MR. GEO. M. HUNT: You would like to raise that from 12 to 16 pounds?

MR. F. D. MATTOS: From 10 to 16 pounds.

MR. J. H. WATERMAN: He would like to have it read 5 to 16 pounds.

MR. GEO. M. HUNT: They do not put in 5 lbs. according to the Boiling process.

MR. F. D. MATTOS: That is in combination with Rueping and Boiling.

MR. J. B. CARD: The Committee has no objection to changing that paragraph "E" to read "10 to 16 lbs. per cubic foot" instead of from 10 to 12 lbs. per cubic foot.

THE PRESIDENT: Are you ready for the question? All those in favor signify it by saying "aye"; contrary, "no." The motion is carried.

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(Mr. Card then read the description of the Boulton process. See page 77).

THE PRESIDENT: What is your pleasure? Is there a motion to adopt this definition of this process?

MR. F. J. ANGIER: Mr. President, I move that the definition of the process be adopted.

MR. J. H. WATERMAN: I second the motion.

THE PRESIDENT: Any comments? All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

(Mr. Card then read the description of the Burnett process. See page 78).

MR. E. H. BOWSER: I move its acceptance.

MR. A. R. JOYCE: I second the motion.

THE PRESIDENT: It has been moved and seconded that we accept this definition. All those in favor signify it by saying "aye"; contrary, "no." The motion is carried.

(Mr. Card then read a description of the Card process. See page 78).

MR. F. J. ANGIER: Mr. President, change the word "creosote" to "oil" in the last paragraph, making it read "2 to 3 lbs. of oil per cubic foot."

THE PRESIDENT: That is accepted by the Committee.

MR. J. H. WATERMAN: I move its adoption.

MR. EARL STIMSON: If that is the case the "creosote" in "A" should be changed.

MR. F. J. ANGIER: Yes.

MR. E. H. BOWSER: I second the motion.

THE PRESIDENT: All those in favor of accepting this definition please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. W. H. GRADY: Mr. President, it seems to me if you are going to make this process read "oil" in place of "creosote," that ought to apply to all the others.

MR. J. B. CARD: The Committee thinks it should apply.

MR. J. H. WATERMAN: We have changed it in two places, so we might as well change it in all.

MR. J. B. CARD: We have changed it in three paragraphs. "A," "B," and the last paragraph.

MR. J. C. WILLIAMS: Mr. President, that brings up the question whether the Card patent covers all oils, or is limited specifically to zinc chloride and creosote only.

MR. L. B. MOSES: That process covers everything in the world (laughter).

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(Mr. Card then read a description of the Lowry process. See page 79).

MR. E. H. BOWSER: I move the acceptance of it.

MR. F. J. ANGIER: I second the motion.

THE PRESIDENT: It has been moved and seconded that we accept this definition. All those in favor signify it by saying "aye"; contrary, "no." The motion is carried.

(Mr. Card then read a description of the Rueping process. See page 79).

MR. J. B. CARD: There is a correction here in paragraph "D." Where it says "the air imprisons during 'a,' expands during 'b,'" that should be 'expands during 'd.'"

THE PRESIDENT: What action do you wish to take on this?

MR. J. C. WILLIAMS: I move it be accepted.

MR. A. R. JOYCE: I second the motion.

THE PRESIDENT: All those in favor signify it by saying "aye"; contrary, "no." The motion is carried.

(Mr. Card then read a description of Steaming process. See page 80).

MR. F. J. ANGIER: Mr. President, I move the adoption of this definition.

MR. J. H. WATERMAN: I second the motion.

THE PRESIDENT: It has been moved and seconded that we adopt this paragraph. All those in favor signify it by saying "aye"; contrary, "no." The motion is carried.

(Mr. Card then read a description of the Wellhouse process. See page 80).

MR. J. B. CARD: The Committee will scratch out the last clause, "the process is not now in extensive use."

MR. H. A. PAUL: I would like to ask the Chairman of this Committee if the Wellhouse process was ever used without a preliminary steaming of ties?

MR. J. B. CARD: Yes, the Wellhouse process was used on seasoned timber without any steaming.

MR. H. A. PAUL: I would like to ask the Chairman what the result was when it was used without preliminary steaming, in absorption as to amount?

MR. J. B. CARD: The seasoned ties would absorb without steaming much better than green ties would that were steamed.

MR. H. A. PAUL: That is not my point. When the dry ties were steamed, given a preliminary steaming, how did the absorption compare with dry ties treated without preliminary steaming?

MR. J. B. CARD: I do not think I could answer that question, because I think everyone discontinued the steaming of seasoned wood

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in the Wellhouse process. In other words, the treatment was so much better without steaming that it was discontinued. You would only add moisture to the wood by steaming it, and therefore there was nothing gained by putting a long steam on dry wood. You would not help the penetration in any way unless possibly with certain kinds of wood that might have casehardened a little in seasoning, in those woods it might have improved their absorption qualities, but the average wood like red oak would take a better absorption without steaming than it would with steaming.

MR. H. A. PAUL: I would like to state that in 1903 the question of dropping the preliminary steaming in the Burnett process, as a means of perhaps turning out more runs from a cylinder during the daily period came up. In an investigation of possibly one hundred runs, the preliminary steaming effected on dry loblolly-pine ties as follows: when the dry ties were not given a preliminary steaming of one hour, they absorbed by actual scale weight 60 lbs. of solution. When they were given a preliminary steaming they absorbed 100 lbs. of solution.

MR. J. B. CARD: That might be true of pine, because pine will have more of a tendency to caseharden in seasoning than hardwoods will. That would probably apply to hemlock also, and may possibly apply to tamarack, but the gain in steaming dry wood is so slight that I question if it would pay you to do it with the majority of woods.

MR. H. A. PAUL: The same was true of western yellow pine and shortleaf pine also. It is true today, I believe, and similar experiments will prove 60 and 100 lbs. approximately correct.

MR. J. B. CARD: In treating hardwoods you will get a much better penetration with seasoned oaks and no preliminary steam than you would by applying steam to them.

MR. F. J. ANGIER: Mr. President, I move the adoption of this paragraph.

MR. G. S. HARDEN: I second the motion.

MR. J. C. WILLIAMS: Mr. President, the last paragraph says:

> The object of the glue, followed by the tannin, is to form a leathery precipitate to plug the pores in the wood and retard the leaching of the zinc chloride.

Under the heading of the Lowry process on the preceding page, the description read that

> The air imprisoned by injecting the oil without a preliminary vacuum expands during the final vacuum forcing out a certain amount of oil with it.

Both of those details are, as I understand it, essential features of those patents. Now if it is stated as a fact that the Lowry process

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does a certain thing, why can it not also be stated as a fact that the Wellhouse process does another certain thing, and the word "object" be left out. This would make the description state the fact that the glue and tannin actually form a leathery precipitate to plug the pores in the wood and retard the leaching of the zinc chloride.

MR. J. B. CARD: There has been an argument over this Wellhouse treatment for a great many years, as to just exactly what the glue and tannin accomplish in the treatment of wood, and the Committee has defined this in stating that the object of this glue and tannin is to form a leathery precipitate. Whether it does or not, I do not know that the Committee cares to state. The patent says that the object of using the glue and the tannin is to do certain things, and I do not think it is for the Committee to say that they do.

MR. J. C. WILLIAMS: Is the Committee satisfied that the Lowry patent does what the Committee states that it does?

MR. J. B. CARD: Yes, the Committee is satisfied with the definition of the Lowry process.

THE PRESIDENT: All in favor of the question signify it by saying "aye"; contrary, "no." The motion is carried. We will have the next process.

(Mr. Card then read the description under Non-Pressure processes. See page 80).

MR. C. H. EASTWICK: Referring to the first paragraph, it is not descriptive of the process. Would the Committee object to omitting that paragraph, on the same ground as applied to the Allardyce process?

MR. A. R. JOYCE: Mr. President, in the description under "Methods" there have been sentences included telling about what the particular method was used for. The first part of this paragraph is all right. It tells what a portion of the treament is used for. The last part might be subject to criticism because it says:

> Where it is impracticable or unnecessary to use a more effective treatment.

The first part certainly could be included.

THE PRESIDENT: Does that satisfy you?

MR. C. H. EASTWICK: That same thing may apply to various processes described here. As I understand it, this is an attempt to describe the process and not describe the relative value, and this paragraph would indicate that it was impractical for many purposes, and, without investigation or report going with this to show the value of the various processes, I think the first paragraph should be omitted. The second paragraph describes clearly what the process is, which I understand is the intention of this article.

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MR. A. R. JOYCE: Mr. President, I move you that this description be adopted, with the elimination in the first paragraph of everything following "Timber." Make the first paragraph read:

Used frequently on poles and structural timber,

and cut out the balance of the first paragraph.

THE PRESIDENT: Is there a second?

MR. J. C. WILLIAMS: I second the motion.

THE PRESIDENT: Gentlemen, you have heard the motion. All those in favor say "aye"——

MR. GEO. M. HUNT: May I suggest an amendment here, which I think will please both gentlemen?

THE PRESIDENT: An amendment to the motion?

MR. GEO. M. HUNT: Yes.

THE PRESIDENT: What is it?

MR. J. B. CARD: The Committee will change this first sentence to read:

Used frequently on poles and construction timber where it is not desirable to use a more effective treatment.

MR. J. C. WILLIAMS: Mr. President, could we not omit the word "frequently" without doing any damage? I think that the fewer adjectives and adverbs we have the better.

MR. WM. A. CECIL: Mr. President, it would be better to cut out the whole paragraph. I know nothing about the brush treatment, but I do not approve of putting anything in that has a tendency to limit the use of any process. In a word, I believe in giving every fellow a chance to build up and expand his business. Now then you say poles and something else there. For the man that did not understand the matter it would look as though it was not good for any other purpose, whereas they might get good service from the brush treatment for something else. I do not believe that the description will be injured by cutting out the paragraph, and I believe that a great many people may be benefited. Therefore, I would say cut it out.

THE PRESIDENT: Is there any discussion on the motion that is before the house?

MR. E. H. BOWSER: Does the motion include that revision of the paragraph?

THE PRESIDENT: The motion is that we accept this report by having the first paragraph read:

Used frequently on poles and construction timber,

and cut out the rest of the first paragraph.

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MR. A. R. JOYCE: Mr. President, I would like to add "posts" to that first paragraph, "posts, poles and construction timber."

MR. WM. A. CECIL: Why not add railroad ties? You may want to use it on them.

MR. C. H. EASTWICK: Mr. President, I could add a great many uses for brush treatment extending over about 50 years, that seem to me unnecessary to mention in this description of the application of it. If the Committee wants a list of where the brush treatment has been used we would be very glad to furnish it, and if this article is to be accurate why only mention poles and construction timber alone, because there are many other uses that it has been put to with satisfactory results.

MR. GEO. M. HUNT: Mr. Chairman, I move as an amendment to Mr. Joyce's motion that the whole first part of the paragraph be changed to read as follows:

> Used frequently on poles, posts and other timbers, in cases where it is not desired to use a more effective treatment.

MR. M. K. TRUMBULL: I second the motion.

THE PRESIDENT: Any comments on the amendment? All those in favor of the amendment signify it by saying "aye." The amendment is adopted. All those in favor of the original motion signify it by saying "aye." I do not know whether this is understood or not. There was an original motion made to accept the definition of this process by changing the first paragraph to read:

> Used frequently on poles and construction timber.

That was amended to make the first paragraph read:

> Used frequently on posts, poles and other timbers in cases where it is not desired to use a more effective treatment.

Now we voted on the amendment, and it was adopted. We are ready to vote on the original question. All those in favor of the original motion accepting the amendment changing the first paragraph, will please signify it by saying "aye." All those opposed signify it by saying "no." The motion is carried.

(Mr. Card then read the description of the Open-Tank treatment. See page 80).

MR. J. B. CARD: The Committee has changed the word "creosote" in paragraph "A" to "oil."

MR. C. H. EASTWICK: On the same ground, not being descriptive, I will ask if it will be consistent for the Committee to omit the last paragraph.

MR. E. T. CHAPIN: A very large share of the poles used in the United States are cedar poles, and this open-tank method of treating

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is the only process, practically speaking, that is used for treating cedar poles. I do not see any reason for stating that there are more practical methods of treating poles. About 75% of the poles in the United States today are cedar, and the method employed for treating cedar poles is open-tank method. In fact, seven modern plants have been installed within the last 18 months. I would suggest that the words be left out, "when it is impracticable or unnecessary to use a more effective treatment" as the open-tank method is efficient.

I would also like to make another suggestion, and that is that the official specifications covering the treatment of poles provide what is called an "A" treatment or the Dipping process, and a "B" treatment, or the Hot and Cold, and I would suggest that the capital letter "A" be used in place of the figure "1," and the capital letter "B" in place of the figure "2," as these are very generally known terms among pole men, and as long as this process is not in general use except for the butt treatment of poles, I would think that this would be a fair thing to do.

THE PRESIDENT: That correction has been made by the Committee.

MR. J. B. CARD: The Committee will change the last paragraph to read as follows:

> These methods are frequently used for posts, poles and other timbers in cases where it is not desirable to use a more effective treatment.

MR. J. C. WILLIAMS: In the introductory sentence, could we not say that the treatment can be "performed" or "done," instead of "made"? You are not manufacturing anything, you are only putting through a process, you are doing something.

MR. J. B. CARD: We can use there "can be accomplished." Does that answer your question?

MR. J. C. WILLIAMS: I think that will cover it.

MR. E. H. BOWSER: I move we accept this paragraph with the description suggested by Mr. Card in the last paragraph.

MR. F. J. ANGIER: I second the motion.

THE PRESIDENT: It has been moved and seconded that this paragraph as amended be accepted.

MR. E. W. BRIGHT: In the way of information I would like to ask this Committee how it determines the period of time from 5 to 15 minutes. In No. 1 where it says,

> Dipping: Consists of submerging the wood in hot preservative for 5 to 15 minutes.

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I think we should eliminate the time there, and not mention time whatsoever, as this should be determined by the material being dipped. I suggest that we leave out the 5 to 15 minutes.

MR. J. B. CARD: We are describing here what is common practice, and that seems to be the practice in the Open-Tank treatment of submerging the wood in hot preservative for 5 to 15 minutes, and not for any longer period of time.

MR. GEO. M. HUNT: Mr. Chairman, in addition to that I would like to say, and I think Mr. Chapin will agree with me, that the Association of Cedar Pole Manufacturers have adopted a specification for Open-Tank treatment, which reads practically as ours does here, and I believe that in it they consider the dipping treatment to be from 5 to 15 minutes.

MR. E. T. CHAPIN: Yes.

MR. GEO. M. HUNT: So in this we are agreeing with what has already been accepted by the Association most concerned.

THE PRESIDENT: Are you ready for the question? All those in favor please signify it by saying "aye"; those opposed, "no." The motion is carried.

(Mr. Card then read the description of the Kyan process. See page 81).

THE PRESIDENT: What shall be done with this paragraph?

MR. F. J. ANGIER: Mr. President, I move the adoption of this paragraph.

MR. G. S. HARDEN: I second the motion.

THE PRESIDENT: Any comments? All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. W. H. GRADY: I move that we accept the definitions covering processes for inclusion in the MANUAL.

MR. A. L. KUEHN: I second the motion.

THE PRESIDENT: We will vote on this motion, to adopt for insertion in the MANUAL the names of processes and their definitions, as presented by the Committee. All those in favor will please signify by saying "aye"; contrary, "no." The motion is carried.

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REPORT OF COMMITTEE ON TERMINOLOGY.

To the Members of the American Wood-Preservers' Association:

Your Committee on Terminology was instructed to present for adoption at the annual meeting, for insertion in the MANUAL, terms of plant equipment and operation, also description of processes used in the United States. We submit herewith our report:

PRINCIPAL PROCESSES USED IN UNITED STATES.

In attempting to describe the various wood-preserving processes it is recognized that the details of the procedure followed may vary at different plants using the same process. In some cases the process has gradually changed in one or more details from that described in the original patent, but still retains its name. In the following descriptions the attempt has been made to give in as few words as possible the essential details of the various processes as used at present, without attempting a rigid definition. If any errors are discovered the Committee will appreciate having same called to its attention.

Pressure Processes.

Allardyce:

Not patented. Used chiefly for ties.

Consists essentially of the following steps:

a. A solution of zinc chloride is forced into the wood at a maximum pressure of 75 to 100 lbs. per square inch until the desired absorption is obtained (commonly ¼ to ½ lb. dry salt per cubic foot).

b. The zinc chloride is then drained from the retort, and creosote admitted and injected into the wood at a pressure of about 100 to 150 lbs. per square inch until the desired absorption (usually 3 to 4 lbs. per cubic foot) is obtained.

The pressures used under *a* and *b* depend upon the character and condition of the wood under treatment. The pressure under *b* however must be higher than that under *a*.

Bethell (Full-Cell Process):

Patented by John Bethell in England in 1838. (See British patent No. 7731, July, 1838.) Commonly used for the creosoting of piles, poles, cross-arms, paving blocks, structural timber, lumber, and ties.

As now practiced consists essentially of the following steps:

a. Preliminary vacuum one-half to one or more hours.

b. Oil injected under pressure, maximum usually between 100 and 180 lbs. per square inch, but sometimes as low as 25 lbs.

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c. Final vacuum (sometimes omitted).

Green timber is usually subjected to a live steam bath at about 20 lbs. pressure for several hours before the preliminary vacuum. Seasoned timber is not usually steamed, except in the case of paving blocks. The amount of oil injected depends upon the specifications of the purchaser, but the absorption per cubic foot is usually within the following ranges:

Lumber, poles, structural timbers, cross-arms, ties, fresh water and land piles, 6 to 12 pounds.

Paving blocks, 12 to 20 pounds.

Salt water piles, 16 to 24 pounds.

Boiling:

Patented by Wm. G. Curtis and John D. Isaacs in 1895, and reissued the same year. (U. S. patent 545,222, and reissue No. 11,515).

Used chiefly for creosoting Douglas fir piles, timber, lumber, ties and paving blocks.

Consists essentially of the following steps:

a. Wood (either green or seasoned) in the treating cylinder is covered with oil at about 160° to 190° F.

b. Oil heated above 212° F. at atmospheric pressure and vapors passed through a condenser. (The practice with regard to temperature limits varies with different plants. In some cases a range of 215° to 225° F. is used, in others 225° to 250° F.)

c. Heating continued until rate of condensation falls to one-sixth to one-tenth of a pound of water per cubic foot of wood per hour. This sometimes requires 40 to 60 hours or more for green timber, but may be as low as 10 hours for dry timber.

d. Treating cylinder partially emptied and refilled with cooler oil to lower oil temperature before starting pressure.

e. Pressure applied, maximum 120 to 180 lbs. per square inch, until desired absorption obtained; usually 10 to 16 lbs. per cubic foot.

Boulton (Boiling Under Vacuum):

Patented by S. B. Boulton in England and the United States. (See U. S. patent 247,602, issued September 27, 1881.) The first mention of boiling under vacuum, however, appears in Bethell's British patent No. 7731, July, 1838. Patent modification applied for in 1915 by O. P. M. Goss.

Used chiefly for the treatment of Douglas fir piles, timber, ties, lumber and paving blocks.

As now practiced it consists essentially of the following steps:

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a. Timber immersed in hot creosote and subjected to a vacuum, and the escaping vapors drawn through a condenser.

b. Temperature (usually 190° to 215° F.) and vacuum maintained until the rate of condensation of water falls to a specified amount per cubic foot of wood per hour—usually one-sixth to one-tenth of a pound.

c. Vacuum discontinued and pressure applied until desired absorption obtained. This is commonly 12 to 16 lbs. per cubic foot for paving blocks, 12 to 14 lbs. for piles, 8 to 12 lbs. for lumber and timber, and 5 to 8 lbs. for ties.

The object of the vacuum is to evaporate the water from the wood at a lower temperature than in the ordinary steaming or straight boiling processes.

The Goss modification provides for a heating period of several hours at atmospheric pressure in oil at a temperature of 190° to 215° F. before the vacuum is applied, and a heating bath in oil at atmospheric pressure after the oil pressure period.

Burnett:

Patented in 1838 in England by William Burnett. (See British patent No. 7747, July, 1838).

In general use for treating ties, lumber, and timber with zinc chloride.

As now practiced consists essentially as follows for seasoned wood:

a. Preliminary vacuum.

b. Zinc chloride solution applied under pressure of 100 to 175 lbs. per square inch, to approximate refusal.

For green timber, a steaming period of 1 to 5 or more hours at about 20 lbs. is usually applied before the vacuum. The strength of the zinc chloride solution is generally so regulated that at refusal the timber will have absorbed from ¼ to ½ lb., usually the latter, of dry zinc chloride per cubic foot.

The original Burnett patent covers only the use of zinc chloride by soaking the wood in 2.4% solution of it for 10 to 21 days. The use of pressure with zinc chloride is a later development.

Card:

Patented by J. B. Card in 1906. (U. S. patent No. 815,404).

Used chiefly for ties, lumber and timber.

The essential parts of the process are:

a. The use of a mixture containing about 80% of zinc chloride solution and 20% of oil.

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b. The method of keeping the zinc chloride and oil mixed during treatment by means of a rotary pump, which draws the mixture from the top of the treating cylinder and returns it at the bottom through a perforated pipe.

The use of steaming, vacuum, and pressure are the same as in the Bethell process.

It is customary to inject about ½ lb. of dry zinc chloride and 2 to 3 lbs. of oil per cubic foot.

Lowry (Empty-Cell Process):

Patented by C. B. Lowry in 1906, (U. S. patent No. 831,450.)

Used chiefly for creosoting air-seasoned cross-ties but also for poles, posts, paving blocks and silo staves.

Consists essentially of the following steps:

a. Without first drawing a vacuum, creosote at not to exceed 200° F. is injected into the wood to refusal, or to a specified amount.

b. A quick vacuum is drawn to remove the excess oil from the timber.

The air imprisoned by injecting the oil without a preliminary vacuum expands during the final vacuum, forcing out a certain amount of oil with it. For this reason the process is classed as "empty-cell."

It is customary to leave in ties a net of about 2½ gals. of creosote per tie, (6 to 8 lbs. per cubic foot), and 6 to 10 lbs. per cubic foot in other timber.

Rueping (Empty-Cell Process):

Patented in the United States in 1902 and 1911 by Max Rueping. (U. S. patents 709,799 and 1,008,864. The first patent was reissued No. 12,707, Oct., 1907).

Used chiefly for ties and lumber.

As commonly used, the process consists of the following:

a. Treating cylinder, containing the wood, is filled with compressed air and so held for an hour or more.

b. Treating cylinder filled with oil allowing air to escape, but without reducing pressure.

c. When treating cylinder is full of oil, pressure is increased to a maximum of 150 to 200 lbs. per square inch, and held to refusal, or until specified absorption obtained.

d. Oil drained and vacuum drawn to remove excess of oil from the wood.

The air imprisoned during *a* expands during *d* forcing out a certain amount of oil with it, and the process is, therefore, called an "empty-cell" process. If desired, *a* may be omitted, and the air pressure applied after *c*.

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If green timber is treated, it is first artificially seasoned by steaming, boiling, or boiling under vacuum, before the pressure is applied.

Net absorption, usually 4 to 6 lbs. per cubic foot.

Steaming (Colman Process):

Not patented.

Used almost exclusively for the treatment of Douglas fir piles.

Consists essentially of the following steps:

a. Timber steamed at a pressure of 50 to 100 lbs. per square inch for 3 to 8 hours; time and pressure varying according to dimension and previous degree of seasoning.

b. Steam released and vacuum drawn until timber is considered seasoned. This usually requires from 7 to 14 hours. The temperature within the treating cylinder during the vacuum period is usually maintained between 180° and 212° F.

c. Oil injected at a pressure of 80 to 140 lbs. per square inch until desired absorption is obtained.

Wellhouse:

Patented in 1879 by Wm. Wellhouse and Erwin Hagen. (See U. S. patent 216,589.)

Used chiefly for ties.

Consists essentially of the following steps:

a. A solution consisting of 1½% to 3% of zinc chloride and ½% of glue is injected into the wood at a pressure of about 125 lbs. per square inch for 3 to 6 hours.

b. The pressure is released, cylinder drained and a ½% solution of tannin is injected at a pressure of about 125 lbs. per square inch for about 2 hours.

The object of the glue, followed by the tannin, is to form a leathery precipitate to plug the pores in the wood and retard the leaching of the zinc chloride.

Non-Pressure Processes.

Brush Treatment:

Used frequently on poles and construction timber.

Consists in applying the hot preservative to the dry timber by means of a brush. Two coats, 24 hours apart, are customarily used.

Open-Tank Treatment.

Can be accomplished in two general ways:

A. *Dipping:*

Consists in submerging the wood in hot preservative for 5 to 15 minutes.

B. *Hot and Cold Bath:*

More effective than A.

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Consists essentially of the following steps:

a. The wood is heated in oil at 200° to 225° F., for one or more hours.

b. It is then either quickly transferred to a tank of cool creosote and allowed to stand several hours, or the heating is discontinued after *a*, and the wood and oil allowed to cool together.

These methods are frequently used for posts, poles, and other timbers in cases where it is not desirable to use a more effective treatment.

Kyan (Kyanizing):

Patented in England by John H. Kyan in 1832. (British patents No. 6,253, Sept., 1832, and No. 7,001, March, 1836.)

Used for ties and construction timber.

Consists in soaking seasoned wood in a solution of mercuric chloride (usually 1%) in an open vat of wood or concrete. It is customary to allow the wood to soak one day more than one day for each inch in thickness.

The original Kyan patent specified a solution of 1 lb. of corrosive sublimate to 5 gals. of water (about 2.4%), and the wood was soaked from 14 to 21 days.

Other preservatives, such as zinc chloride or sodium fluoride in water solutions, may be used in the same manner, except that the solutions should be stronger.

The term Kyan process or Kyanizing, however, is limited to the use of mercuric chloride. When other preservatives are used the process is called "steeping" or "soaking."

J. B. CARD, *Chairman*
E. T. HOWSON
GEO. M. HUNT
G. B. SHIPLEY
M. K. TRUMBULL

THE PRESIDENT: I wish to announce that tomorrow we will have a paper illustrated by slides on "The Bad and the Good in the Handling of Wood," by Mr. Waterman. This will be followed by a talk illustrated with slides on the same subject by Mr. Rex. I am sure that the members will find these two talks very interesting.

I now have the pleasure of introducing to you one of the oldest men in the wood-preserving industry, and a pioneer in the industry in the West, I want you to see and meet Mr. J. D. Isaacs (applause).

MR. J. D. ISAACS: Gentlemen, I am very glad to have the pleasure of an introduction to you, but I am very sorry that circum-

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stances have been such that I could not attend any of your meetings heretofore. I have watched the progress of this Association with great interest. You are doing a fine work. You have raised this from a mere cut-and-dry matter to a profession and an art and a science, and I hope you will keep on with the good work. I thank you, indeed, for this introduction (applause).

THE PRESIDENT: If there is no further business to be brought before the Association, we will adjourn until 10 o'clock tomorrow morning. We have a very full day tomorrow and I hope that we can get to work early.

An adjournment was then taken.

WEDNESDAY MORNING SESSION.

January 24.

The meeting was called to order at 10 o'clock A. M. by President Crawford.

THE PRESIDENT: Our Secretary has a communication he would like to read.

SECRETARY ANGIER: This is a telegram from R. L. Allardyce, Texarkana, to C. M. Taylor:

> Regret cannot attend meeting on account of contracting severe cold. Hope you will have a good meeting. Remember me to all.
> ALLARDYCE.

THE PRESIDENT: I would like to ask if the Entertainment Committee has any announcement this morning. Are any members of the Entertainment Committee here? If not, we will have the report on Service Tests of Ties and Structural Timber, which was left over from yesterday. I would like to say before the Committee makes the report that there are a great many tables and data accompanying this report, which have not been printed, due to the lack of time after the report was turned over to the Executive Committee, but will be printed in the PROCEEDINGS. The Secretary will call the names of the Committee.

SECRETARY ANGIER: Mr. C. P. Winslow, Chairman, Mr. E. H. Bowser, Mr. C. F. Ford, Mr. C. E. Gosline, Mr. F. D. Mattos, Mr. H. M. Rollins, Dr. Hermann von Schrenk and Mr. T. G. Stull.

THE PRESIDENT: Mr. Winslow cannot be here, and Mr. Gosline has been asked to take charge of the Committee in presenting the report. The gentlemen whose names have been called, please come forward and take chairs on the rostrum.

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MR. C. E. GOSLINE: Mr. President and Members: The report as outlined in this pamphlet has been made up almost entirely by Mr. Winslow and his office force, and there is nothing new or startling in it. It is simply following up and compiling the tables and tabulating the records of different railroads on tests. There are some thirty or forty tables to go along with this report. These tables lack information on records of water-gas-tar mixtures and crude oil. It is the desire of the Committee that a recommendation be made that we try to get these records which are lacking.

There are also a number of railroads that have not made any report of any service tests on ties, which they have in tracks, and which would be of very great value to the Association, and would make the tabulations and records very much more complete. I do not know that there is anything more to add to the report, as we went over the same thing last year. I do not believe there is any necessity for taking up any more time.

REPORT OF COMMITTEE ON SERVICE TESTS OF TIES AND STRUCTURAL TIMBER.

To the Members of the American Wood-Preservers' Association:

The instructions issued to your Committee by the Executive Committee of the Association were substantially as follows:

1. Continue the compilation and tabulation of all data which can be secured on service tests of ties in both steam and electric roads, indicating in each record the kind of wood, the method of treatment, and all other data which will be of value. Similar data should be secured so far as is possible for ties, poles, piles, posts, bridge timber and in fact, for all timber except paving blocks.

2. Point out on what species of wood and character of treatment service records are lacking.

3. Make further recommendations as to how additional data may be effectively procured.

4. Present recommendations for future work to be undertaken by your Committee.

The following briefly outlines the progress which has been made by your Committee in accordance with the foregoing instructions:

1. Continuation of the Compilation and Tabulation of Data, etc.

First attention has been given to ties in steam roads. A systematic collection, compilation and tabulation of data of this character has been undertaken by the Forest Products Laboratory in co-operation with your Committee and also in co-operation with the Committee on Wood Preservation of the American Railway Engineering Association.

The general plan is for the various railroads to annually submit a report showing their results with various test tracks, and experimental ties, which are then classified, co-ordinated and tabulated systematically.

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The results of this work for the current year are embodied in a report, with the accompanying tables, entitled "Service Tests of Cross-Ties" by P. R. Hicks, under whose supervision the work was conducted, and who has kindly furnished his complete report for the use of the Committee.

With a view to securing similar data for ties used in electric railways as is now currently being secured for ties in steam roads, the matter was taken up with officers of the American Electric Railway Engineering Association. Forms of the submission and recording of data have been prepared and submitted to this Association, and while time has not yet permitted a systematic collection and tabulation of data of this character, it is confidently expected that during the ensuing year it will be possible to secure exhaustive records from this source.

Service-test records on posts and poles are presented by Mr. Hicks, who has kindly furnished this report for the use of the Committee. Data on other forms of timber have also been collected to a certain extent but time has not permitted the systematic tabulation and presentation of the result.

2. Species of Wood and Character of Treatment on Which Service Records are Lacking.

A perspective view of the character of the records for ties in steam roads can best be obtained by reference to Table 2 in the accompanying report by Mr. Hicks.

A study of his data further shows that no authentic records are at present available for Port Orford cedar or redwood ties, while only a few records are available on western hemlock, white fir, western red cedar, and some of the oaks and pines. Special emphasis should, therefore, be laid in the future to procuring data on these species, both treated and untreated.

3. Recommendations as to How Additional Data May be Effectively Procured.

Additional data cannot only be effectively procured, but the work of collection, tabulation and analysis of data can be greatly assisted by observance of the following:

(*a*) Prompt compliance by various companies having test tracks, or other experimental timber installed, with requests for annual reports on the character and condition of the experimental timber. While the co-operation and assistance of the many companies furnishing the information upon which the tabulations accompanying this report are based is sincerely appreciated, the furnishing of this data prior to October 1 of each year would greatly facilitate the Committee in the

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arrangement and proper analysis of the material in time for presentation at the annual meeting of the Association.

(*b*) So far as practicable the data should be furnished on standard forms which should be approved and provided by the Committee for that purpose, and an earnest attempt should be made to provide all of the information called for in such forms. This procedure would greatly facilitate in the annual tabulation and analysis of the data.

(*c*) The co-operative work with the American Electric Railway Association should be supported and developed. It is believed that a considerable amount of valuable data may be procured through the various companies of this Association. A compilation and analysis of data on ties used in electric railways both in interurban tracks and in tracks in paved and unpaved streets is a phase of the subject which has not yet received the careful attention it deserves.

(*d*) As the work develops similar co-operative arrangements should be effected with other associations or organizations which can assist in procuring records of other forms of timber, such as poles, posts, mine timber, etc.

4. Recommendations for Future Work.

It is the feeling of your Committee that the annual compilation of durability records on the systematic basis which has now been established should be continued and a strong effort should be made not only to continue this work for steam roads but to develop it to cover, first, ties in electric roads and subsequently, as rapidly as possible, other forms of timber.

C. P. WINSLOW, *Chairman.*
E. H. BOWSER,
C. F. FORD,
C. E. GOSLINE,
F. D. MATTOS,
G. L. POLLOCK,
H. M. ROLLINS,
H. VON SCHRENK,
T. G. STULL.

SERVICE TESTS OF CROSS-TIES.

By P. R. Hicks.

(January, 1917.)

Engineer in Forest Products,
Forest Products Laboratory, Madison, Wis.

The records embodied in the accompanying tables were compiled as a continuation of the report written by C. P. Winslow and C. H.

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Teesdale, published in the 1916 PROCEEDINGS, and will be compiled annually hereafter. They comprise 872 records on 61 species, of which 53 were completed. The report published in 1916 includes all records upon which information was available at the time the report was prepared. In the present report those records upon which no additional information could be obtained were eliminated. Several new service-test records not previously reported were submitted during 1916 and are included in the present report.

Acknowledgement is made to the railroad officials who furnished the information, data, and records upon which this report is based.

In compiling these data, letters were sent to all railroad companies known to have service-test records and to many others. These letters were written about September 1, 1916, requesting the information by October 1, 1916, although most of the data were received during the latter part of November and December. While it is realized that inspections in many cases are made late in the year, and that it requires considerable time to write up these inspections, it is desired to emphasize the fact that if the records are received early they can be summarized in time for publication prior to the annual meeting of the Association.

Furthermore, the records could be improved by including such items as dimensions of the ties, tie-plated or not, size of tie-plates, kind of spikes, traffic in tons per annum, weight of rail, ballast, placed on curve or tangent, percentage of grade, spacing in the track, cause of removal, etc., all of which have a more or less direct bearing upon the durability.

The greater part of the accompanying records are from reports of actual test tracks. This should make the records most valuable, as many of the railroads have learned that records can be kept more accurately in this manner than by trying to keep a record of all the ties in one division or system, as was brought out by F. J. Angier at the 1911 meeting of the American Wood-Preservers' Association.

Table 1 gives a list of the number of records and species submitted by the various railroads, and is self-explanatory. Other railroads undoubtedly have experimental tracks or accurate durability records, and it is the writer's desire to be informed of these companies not now included so that a complete list may be had.

Table 2 gives the number of completed and unfinished records for the various treatments, and Table 3 an itemized statement of those which have been completed.

Forty completed records are given for 18 untreated species on six railroads, seven for four Burnettized species on three lines, and six for five species treated by three other methods. Of the latter, beech, red

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oak, and loblolly pine treated by Long's liquid and placed on the Illinois Central in Mississippi had an average life of 4¼, 4¾, and 5½ years, respectively, which indicates this preservative was not a success. The same is true of the red oak ties treated with creosol-calcium, the average life being but four years.

The Douglas fir was divided where possible into the true Coast fir and that grown in the Rocky Mountains. The average life of 100 unseasoned Coast fir ties laid with cut spikes without tie-plates was 7.5 years, although the 557 green ties in the track laid with various fastenings gave an average life of 8.3, as compared with 8.4 years for 1078 seasoned ties in the same location. The average life of 570 green Mountain fir ties in another location was 7.6 years compared with 7.7 years for 571 seasoned ties. A direct comparison of the Coast and Mountain variety cannot be made, however, on account of climatic conditions. The Coast fir was laid in a much more favorable location compared with that of the Mountain variety.

The average life of 1095 southern yellow pine ties treated with zinc-creosote (process not stated) was 15.6 years, while 16 tupelo gum ties treated in the same way lasted but 8.5 years on the G. H. and S. A. Railway. Forty-five Burnettized red gum ties placed by this company averaged 6 to 7 years. Two groups of 67 and 68 longleaf pine Burnettized ties averaged 14.8 and 14.4 years, Coast Douglas fir 10 to 11 years, and southern sap pine 5.4 and 5.7 years, all of which were treated with zinc chloride in the tracks of the N. Y., N. H., & H., Southern Pacific, and the G., H., & S. A. Railways, respectively.

Attention is called to the untreated completed records submitted by the C., B., & Q. Railroad, where the average life of several species was less in the Lines East than in the Western Lines.

It is noted that no authentic records were obtainable for Port Orford cedar and redwood ties, and only a few records are available on western hemlock, white fir, western red cedar, and some of the oaks and pines. Hence it is particularly desirable to obtain records on both treated and untreated ties of these species.

The following statement submitted by J. H. Waterman of the C., B., & Q. Railroad, is of general interest, as it summarizes the various treatments by species, and is an average of the conditions on 20 divisions of this railway in the states of Wisconsin, Illinois, Missouri, Iowa, Nebraska, Colorado, South Dakota, and Wyoming.

These ties were set in 1909, also 1910, which fact should be kept in mind in analyzing the tables. A general summary, regardless of species, follows:

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Ties Placed in Experimental Tracks, C. B. & Q. Railroad, 1909-1910(a).

Process.	Total Placed.	Total Removed to Jan. 1917.	Per Cent. Removed Acct. Decay	Per Cent. Removed to Jan. 1917. Other Causes.
ASH.				
Straight Creosote	35	...	....	..
Card	388	12	0.5	2.5
Burnett	31	...	....	..
Untreated..... ..	116	103	87.0	1.7
BIRCH.				
Straight Creosote	133	...	....	..
Card	1075	20	0.3	1.7
Burnett	103	3	1.9	1.1
Untreated	217	217	98.0	..
CYPRESS.				
Straight Creosote	54	...	....	..
Card	662	6	0.2	0.3
Burnett	55	...	....	..
Untreated	225	115	51.0	..
COTTONWOOD.				
Straight Creosote	133	...	....	..
Card	456	8	....	2.0
Burnett	..	...	....	..
Untreated	86	86	96.0	4.0
ELM.				
Straight Creosote	328	7	0.7	1.3
Card	957	12	0.5	0.5
Burnett	297	6	0.7	1.3
Untreated	190	163	82.0	4.0
SOFT MAPLE.				
Straight Creosote	201	4	0.5	1.5
Card	731	28	0.5	3.5
Burnett	182	9	1.0	4.0
Untreated	125	122	98.0	..
RED GUM.				
Straight Creosote	137	2	....	1.0
Card	661	17	1.0	2.0
Burnett	119	24	15.0	5.0
Untreated	151	147	96.0	1.0
HEMLOCK.				
Straight Creosote	235	1	....	4.0
Card	1298	26	0.1	1.9
Burnett	213	3	1.0	..
Untreated	191	174	90.5	0.5
BEECH.				
Straight Creosote	484	...	....	..
Card	1226	18	....	1.0
Burnett	315	14	0.3	3.7
Untreated	207	181	85.0	2.0
HICKORY.				
Straight Creosote	25	...	....	..
Card	290	13	0.7	3.3
Burnett	24	...	....	..
Untreated	110	88	76.0	4.0
POPLAR.				
Straight Creosote	80	...	....	..
Card	645	38	1.0	5.0
Burnett	80	2	1.5	1.5
Untreated	125	108	83.0	3.0
HARD MAPLE.				
Straight Creosote	116	...	....	..
Card	831	15	0.5	1.5
Burnett	65	1	....	2.0
Untreated	121	111	91.0	1.0

(a) The above data do not include all the experimental ties in C. B. & Q. tracks.

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Ties Placed in Experimental Tracks, C. B. & Q. Railroad, 1909-1910(a).

(Continued.)

Process.	Total Placed.	Total Removed to Jan. 1917.	Per Cent. Removed Acct. Decay	Per Cent. Removed to Jan. 1917. Other Causes.
PIN OAK.				
Straight Creosote	321	...	....	..
Card	333	5	....	1.0
Burnett	62	...	....	..
Untreated	125	88	70.0	..
LOBLOLLY OR SAP PINE.				
Straight Creosote	205	...	....	..
Card	1344	74	2.0	4.0
Burnett	200	17	5.0	4.0
Untreated	249	208	83.0	1.0
CHESTNUT.				
Straight Creosote	..	...	....	..
Card	253	88	.....	35.0
Burnett	..	...	....	..
Untreated	253	95	8.0	29.0
RED OAK.				
Straight Creosote.....	284	1	....	0.4
Card	1280	26	0.1	1.9
Burnett	272	9	0.7	2.3
Untreated	209	188	87.0	3.0
SYCAMORE.				
Straight Creosote.....	90	1	1.0	..
Card	521	25	2.0	3.0
Burnett	90	4	1.0	2.0
Untreated	130	129	97.0	2.0
TAMARACK.				
Straight Creosote.....	212	...	....	..
Card	1309	5	0.2	0.2
Burnett	214	3	....	1.0
Untreated	175	159	90.0	1.0
TUPELO GUM.				
Straight Creosote.....	151	...	.....	..
Card	671	10	....	1.0
Burnett	117	5	2.0	2.0
Untreated	136	136	100.0	..
WHITE OAK.				
Straight Creosote.....	40	...	.....	..
Card	386	9	....	2.0
Burnett	42	...	.....	..
Untreated	124	13	10.0	..

(a) The above data do not include all the experimental ties in C. B. & Q. tracks.

SUMMARY.

Process.	Total Placed.	Total Removed to Jan. 1917.	Per Cent. Removed Acct. Decay	Per Cent. Removed to Jan. 1917. Other Causes.
Straight Creosote.....	3264	16	0.2	0.3
Card	15817	455	0.4	2.5
Burnett	2488	100	2.0	2.0
Untreated	3270	2626	77.0	3.0

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TABLE 1.—SERVICE-TEST RECORDS OF CROSS-TIES—1916.

Railroad	Reference Number	Creosote				Untreated	Zinc Chloride Burnett	Zinc-Creosote			Zinc Tannin Wellhouse	Others	Species of Wood	Total Number
		Full Cell	Open Tank	Lowry	Rueping			Allardyce	Card	Not Stated etc.				
A. C. Line	49.00	1	...	...	...	...	...	...	...	...	...	...	1	1
A. T. & S. F.	45.10	...	...	...	17	2	4	...	...	...	...	...	4	22
B. & O.	4.11	2	...	...	...	3	...	...	2	...	...	1	4	8
B. A. & P.	34.00	1	...	...	...	...	...	...	...	...	...	...	1	1
C. & A.	50.00	...	...	...	...	...	1	...	...	...	...	...	1	1
C. & E. I.	8.10	...	...	2	...	1	13	...	...	...	6	3	6	25
C. & N. W.	48 & 26	...	2	...	...	9	5	...	8	...	56	...	4	80
C. & W. I.	17.00	...	...	...	...	...	...	...	...	...	5	...	1	5
C. B. & Q.	5.20	71	1	1	3	73	67	2	84	...	...	3	24	310
C. I. & L.	51.00	...	...	10	...	...	...	...	...	...	...	...	3	10
C. M. & St. P.	6.11 & 27	4	...	...	4	18	15	...	9	4	...	5	14	59
C. R. I. & P.	36.00	...	...	...	...	2	...	...	...	...	1	...	1	3
D. L. & W.	44.10	3	...	7	...	1	...	...	...	...	...	...	4	11
Georgia	34.00	2	...	...	...	...	...	...	...	...	...	...	1	2
Great Northern	40.10	2	...	...	...	12	24	...	...	...	...	...	7	38
Illinois Central	12.11	...	...	...	14	7	12	...	...	...	...	4	9	37
Indiana Railways (2)	46.00	...	...	...	...	...	...	...	...	...	...	9	3	9
L. & N.	18.00	2	...	...	...	...	1	...	...	...	...	...	2	3
N. Y. Central	14.10	...	...	26	...	...	...	...	...	...	...	...	3	26
N. Y., N. H. & H.	38.10	3	...	...	...	...	2	...	...	...	...	...	2	5
Norfolk Southern	16.10	2	...	...	...	8	...	...	...	...	3	...	2	13
Northern Pacific	19 & 25	16	...	13	3	29	4	...	...	...	3	5	16	68
O. W. R. R. & N.	28.00	1	...	...	...	2	3	...	...	...	...	1	1	7
Pennsylvania	20.11	2	...	...	2	3	...	...	...	...	...	...	5	7
P. S. & N.	1.761	...	...	...	...	3	...	...	...	...	...	...	2	3
Picatinny Arsenal	28.00	...	...	...	...	...	...	...	...	...	...	2	2	2
Q. & C.	47.00	6	...	...	...	...	...	...	...	...	...	...	4	6
St. L. & S. F.	30.30	3	...	...	3	...	...	...	...	...	...	2	2	8
St. L. S. W.	35.00	9	...	...	...	...	...	2	...	...	...	...	5	11
Southern Pacific	32.10	...	...	...	...	...	7	...	...	...	...	3	3	10
Sunset Central (G. H. & S. A.)	7.10	20	...	...	...	12	14	...	...	13*	...	3	7	62
Tenn. C. I. & Ry.	21.00	2	...	...	...	2	...	...	...	...	...	4	3	3
Total (33)		152	3	64	46	187	172	4	103	17	74	50	61	872

*Similar to Allardyce treatment.

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TABLE 2.—SERVICE TESTS OF CROSS-TIES—RESULTS OF 1916 INSPECTION.

Treatment	Number of Species	Number of Records			Number of Railroads		
		Completed	Unfinished	Total	Completed	Unfinished	Total
Untreated	37	40†	147	187	6	17	17
Rueping	13	..	46	46	..	7	7
Lowry	19	..	64	64	..	6	6
Creosote (Full Cell or Bethell)*	31	..	152	152	..	19	19
Creosote Open-Tank	3	..	3	3	..	2	2
Zinc Chloride	32	7‡	165	172	3	13	14
Card	24	..	103	103	1	5	5
Allardyce	4	..	4	4	..	2	2
Wellhouse	6	..	74	74	..	6	6
Others	20	6§	61	67	2	12	14
Total	61	53	819	872	9	33	33

*Includes a few items such as "Creosote," Creosote Steamed," etc.
†18 species on 6 railways. ‡4 species on 3 railways. §5 species on 2 railways.

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SUMMARY OF COMPLETED RECORDS.

Species.	Number of Ties.	Set. Date	Treatment.	Railroad.	Average Life. Years.	Remarks.
Ash	54	1909	Untreated	C. B. & Q.	4.6	Lines East.
Beech	48	1910	Long's Liquid	I. C.	4.25	
Birch, red	30	1910	Untreated	C. B. & Q.	3.4	" West.
Cottonwood	56	1909	"	"	2.6	" East.
Cypress	374	1895	"	G. H. & S. A.	15.2	
"	654	1895	"	"	15.2	
Elm, white	30	1910	"	C. B. & Q.	5.1	" West.
Fir Douglas—(Coast)	100	1906	"	N. P.	7.5*	Ave. life of 1078 seasoned ties, 8.4 years. Ave. life of 577 green ties, 8.3 years.
" " "	45 mi.	1903	Burnett	S. P.	10.11	
" " "	3.6 mi.	1903	"	"	10.11	
" " (Mountain)***	571	1907	Untreated	N. P.	7.7	Seasoned ties.
" " "	295	1907	"	"	7.6	Green ties.
Gum, red	45	1905	Burnett	G. H. & S. A.	6.7	
" tupelo	48	1909	Untreated	C. B. & Q.	4.0	Lines West.
" "	88	1909	"	"	2.9	" East.
" "	16	1905	Zinc-Creosote	G. H. & S. A.	8.5	
Hemlock, eastern	85	1909	Untreated	C. B. & Q.	4.2	" "
" "	20	1907	"	C. & N. W.	6.5	
" "	20	1907	"	"	6.3	
" western	100	1906	"	N. P.	7.3	
" "	103	1906	"	"	7.3	
Larch	92	1907	"	"	7.3**	Ave. life for 551 green ties is 7.3 years.

*Laid with cut spikes and no tie-plates. (See remarks for average life of all ties in test.)
**Average life for all ties in test. (See remarks.)
***Subdivided into 10 records in the tables.

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SUMMARY OF COMPLETED RECORDS.—*(Continued)*.

Species.	Number of Ties.	Date Set.	Treatment.	Railroad.	Average Life. Years.	Remarks.
Larch	90	1907	Untreated	N. P.	7.4**	Ave. life for 568 seasoned ties is 7.4 years.
"	90	1907	"	"	7.4**	Ave. life for 568 seasoned ties is 7.4 years.
Maple, hard	52	1909	"	C. B. & Q.	3.8	Lines East.
" "	30	1909	"	"	4.7	" West.
" soft	29	1909	"	"	4.1	" "
" "	14	1910	"	"	3.9	" "
Oak, chestnut	424	1904	"	B. & O.	7.7	
" red	9	1910	Cresol-Calcium	I. C.	4.0	
" "	50	1910	Long's Liquid	"	4.75	
" "	59	1909	Untreated	C. B. & Q.	5.0	" "
" "	1900	1907	"	Penn.	5.75	
Pine, loblolly	174	1910	Long's Liquid	I. C.	5.5	
" longleaf	184	1905	Untreated	G. H. & S. A.	4.0	
" "	67	1901	Burnett	N. Y., N. H. & H.	14.8	
" "	68	1901	"	"	14.4	
" sap	334	1905	"	G. H. & S. A.	5.4	Laid with screw spikes.
" "	334	1905	"	"	5.7	Laid with cut spikes, without tie-plates.
" southern yellow	1095	1895	Zinc-Creosote	"	15.6	
Sycamore	15	1910	Untreated	C. B. & Q.	3.9	Lines West.
"	25	1910	"	"	3.2	" East.
Tamarack	47	1909	"	"	4.9	" West.
"	85	1909	"	"	4.7	" East.
"	62	1907	"	C. & N. W.	6.5	

*Laid with cut spikes and no tie-plates. (See remarks for average life of all ties in test.)
**Average life for all ties in the test. (See remarks.)
***Subdivided into 10 records in the tables.

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"	" "	Birch, red	106, 107
"	" "	Chestnut	110, 111
"	" "	Cottonwood	112, 113
"	" "	Cypress	114, 115
"	" "	Elm, white	118, 119
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"	" "	Oak, red	170, 171
"	" "	Oak, white	186, 187
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"	" "	Pine, lodgepole	196, 197
"	" "	Pine, longleaf	200, 201
"	" "	Pine, shortleaf	200, 201
"	" "	Pine, southern yellow	206, 207
"	" "	Poplar	214, 215
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"	"	Pine, lodgepole	196, 197
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"	"	Pine, lodgepole	196, 197
"	"	Pine, shortleaf	202, 203
"	"	Pine, southern yellow	206, 207
"	"	Spruce	216, 217
"	"	Tamarack	220, 221
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"	.....	Pine, lodgepole	196, 197
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"	.....	Poplar	214, 215
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" "	"	Beech	102, 103
" "	"	Birch, red	106, 107
" "	"	Chestnut	112, 113
" "	"	Cypress	116, 117
" "	"	Elm, white	120, 121
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" "	"	Hemlock, eastern	142, 143
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" "	"	Larch, western	154, 155
" "	"	Maple	158, 159
" "	"	Maple, hard	160, 161
" "	"	Maple, soft	164, 165
" "	"	Oak, black	164, 165
" "	"	Oak, pin	168, 169
" "	"	Oak, red	180–185
" "	"	Oak, white	188, 189
" "	"	Pine, loblolly	194, 195
" "	"	Pine, lodgepole	196, 197
" "	"	Pine, longleaf	200, 201
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" "	"	Cottonwood	114, 115
" "	"	Cypress	116, 117
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" "	"	Gum, red	138, 139
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" "	"	Maple, soft	164, 165
" "	"	Oak, pin	168, 169
" "	"	Oak, red	184, 185
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" "	"	Pine, southern yellow	208, 209
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Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
							ASH.						
						CREOS	OTE—(FUL	L-CELL).					
1.1				19				9.62	1910	C.B.&Q.	Lines East		
1.2				1				9.62	1909	"	" West		
1.3				15				9.62	1910	"	" "		
						CR	EOSOTE—(	LOWRY.)					
2.1	7x9x8	Hewed	Seasoned	44	Minn.	19 to Rl.	22.8	6.50	1908	N.P.	Sumner, Wash.	Tang.	0
						CR	EOSOTE—(	RUEPING	).				
						(See	Beech, Index	Nos. 3.2-3.3	.)				
							UNTRE	ATED.					
3.1				54					1909	C.B.&Q.	Lines East		
3.2				14					1910	"	" "		
3.3				30					1909	"	" West		
3.4				15					1910	"	" "		
						ZINC	CHLORIDE	—(BURNE	TT).				
						(See	Beech Index	Nos. 9.8-9.1	0).				
4.1				16				0.50	1910	C.B.&Q.	Lines East		
4.2			Seasoned 1 year	15				0.50	1910	"	" West		
						ZINC-	CREOSOTE	—(CARD).					
5.1				148				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
5.2				123				Zn. 0.50 Cre. 3.00	1910	"	" "		
5.3				88				Zn. 0.50 Cre. 3.00	1909	"	" West		
5.4				15				Zn. 0.50 Cre. 3.00	1910	"	" "		
5.5	6x8x8			325				Zn. 0.50 Cre. 2.00	1908	C.&N.W.	St. Francis, Wis.		

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Service Conditions—*(Continued)*.							Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Refer-ence No.
					ASH—(*Continued*).										
					CREOSOTE—(FULL-CELL).										
1.1	All		Cut	90	Sheridan Burnt Clay & Cin.		1916	6.	0						5.20
1.2	Yes		"	85	"		1916	7.	0						5.20
1.3	"		"	90	Lyons Stone		1916	6.	0						5.20
					CREOSOTE—(LOWRY).										
2.1	Flat	6x8¼ 9/16	"	85	Gravel	Heavy	1915	7.	0			O. K.			19.00
					CREOSOTE—(REUPING).										
					(See Beech, Index Nos. 3.2-3.3).										
					UNTREATED.										
3.1	Yes		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	100.00				4.6		5.20
3.2	All		"	90	Gravel		1916	6.	71.40						5.20
3.2	Yes		"	75-85-90	Cin., Gr., Rock		1915	6.	100.00						5.20
3.4	"		"	90	Burnt Clay		1916	6.	60.00						5.20
					ZINC CHLORIDE—(BURNETT).										
					(See Beech Index Nos. 9.8-9.10).										
4.1	All		Cut	90	Gravel		1916	6.	0						5.20
4.2	Yes		"	90	Lyons Stone		1916	6.	0						5.20
					ZINC-CREOSOTE—(CARD).										
5.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	6.30						5.20
5.2	"		"	90	Gravel		1916	6.	0						5.20
5.3	Yes		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	2.30						5.20
5.4	"		"	75-85-90	Lyons Stone		1916	6.	0						5.20
5.5				90	Slag		1916	8.	2.10						48.00

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
							BEECH.						
						CR	EOSOTE—(	FULL-CEL	L).				
1.1				206				11.12	1909	C.B.&Q.	Lines East		
1.2				99				11.12	1910	"	" "		
1.3				119				11.12	1909	"	" West		
1.4				44				11.12	1910	"	" "		
1.5	7x9x8½	Hewed Sawed	Peeled Seasoned	250			Gal. 2.5	Gal. 0.675	1911	B.&O.	Windsor, O.		
1.6	7x9x8½		Steamed	255					1908	D.L.&W.	Boonton, N. J.		
						CR (	EOSOTE—(See Oak Index	GIUSSANI No. 14.1.)	).				
						CR	EOSOTE—(	LOWRY.)					
2.1	7x9x8½		Seasoned	812			Gal. 5		1913	D.L.&W.	Paterson, N. J.		
2.2	7x9x8½		"	158,000			Gal. 3.5		1910-11	D.L.&W.	Cut-off		
2.3	6x8x8	Sawed	"	198	Ind.	20"	18.7	7.0	1914	C.I.&L.	Lafayette, Ind.	Tang.	.5
2.4	6x8x8	Hewed	"	198	"	20"	30.1	11.3	1914	"	"	"	.5
						CR	EOSOTE—(	RUEPING	).				
3.1	6x8x8	Sawed Hewed		202				5.0	1909	I.C.	Kankakee, Ill.		
3.2	6x8x8	Sawed Hewed	Well Seasoned	274				5.0	1909	"	Fulton, Ky.		
3.3	6x8x8	Sawed Hewed	"	274				5.0	1910	"	Greenville, Miss.		
3.4	6x8x8	Sawed Hewed		248					1910	"	Bloomington, Ill.		
						CRE	OSOTE AND	CRUDE O	IL.				
4.1				5					1911	C.B.&Q.	Baders, Ill.		

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Indx No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. In-spected	Time Service	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Refer-ence No.
					BEECH—(*Continued*).										
					CREOSOTE—(GULF COAST LOWLAND).										
1.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	0						5.20
1.2	"		"	90	Gravel		1916	6.	0						5.20
1.3	Yes		"	85-90	Cin.,Gr.,Bt.C.,Rk		1916	7.	0						5.20
1.4	"		"	90	Lyons Stone		1916	6.	0						5.20
1.5	Shoulder Flange		"	90	Gravel	10,586,000	1916	5.	0			98.8% Good		1.2% Decayed. Includes gum	4.11
1.6	Wal-haupter		"	101	Stone		1916	8.	0					Includes birch and maple	44.10
					CREOSOTE—(GULF COAST LOWLAND). (See Oak Ind ex No. 14.1).										
					CREOSOTE—(LOWLAND).										
2.1	D.L.&W.		Screw	101	Stone		1916	3.	0					Includes birch and maple	44.10
2.2	"		"	101-91	"		1916	4 & 5	0						44.10
2.3	Economy	7	Cut	90	Gravel	5,297,567	1916	2.	0			Excellent		Treated July, 1913 Placed, June, 1914.	51.00
2.4	"	7	"	90	"	5,297,567	1916	2.	0			"			51.00
					CREOSOTE—(RUEPING).										
3.1	Sellers	6x8	Cut	90	Stone		1916	7.	11.40					Removed acct. derailment. 50% tie plated. Includes gum.	12.11
3.2	"	6x8	"	90	Gravel		1916	7.	3.30		3.30			Includes ash, elm, gum, chestnut and maple.	12.11
3.3	"	6x8	"	75	Dirt, Gr., Since		1916	6.	1.80		1.80			*Worn out and split, badly creeping track. Includes ash, elm, gum, chestnut and maple.	12.11
3.4	"	6x8	"	75	Gravel		1916	6.	0					50% tie plated. Includes chestnut, elm and gum.	12.11
					CREOSOTE AND DC RUDE OIL.										
4.1	Yes		Cut	75	Gravel		1916	5.	0					No tie plates under joints	5.20

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
					CRE	OSOTE,	BEECH—80%; TAR,	(*Continued* 20%—(LO	d). WRY).				
5.1	6x8x8	Sawed	Seasoned 6 mos.	1,507	Ill.		8.46	2.54	1912	C.&E.I.	Tuscola, Ill.		
6.1				6			CRUDE OIL.		1911	C.B.&Q.	Baders, Ill.		
7.1			Seasoned	48			J. M. LONG'S	LIQUID. 0.287	1910	I.C.	Greenville, Miss.		
							UNTRE	ATED.					
8.1				110					1909	C.B.&Q.	Lines East		
8.2				23					1910	"	" "		
8.3				58					1909	"	" West		
8.4				15					1910	"	" "		
						ZINC	CHLORIDE	—(BURNE	TT).				
9.1				106				0.50	1909	C.B.&Q.	Lines East		
9.2				104				0.50	1910	"	" "		
9.3				60				0.50	1909	"	" West		
9.4				44				0.50	1910	"	" "		
9.5	6x8x8	Sawed	Air-Seasoned	500		18 to Rl.	1⅛	0.50	1911	C.M.& St.P.	Minneiska, Minn.	"	0
9.6	6x8x8	Sawed	Seasoned 8 mos.	28	Ky.		1.417	.511	1912	C.&E.I.	Tuscola, Ill.		
9.7	6x8x8	Hewed	Seasoned 8 mos.	775	"		1.417	.511	1912	"	"		
9.8	6x8x8	Sawed Hewed	Seasoned	274				0.50	1909	I.C.	Kankakee, Ill.		

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Service Conditions—*(Continued)*.							Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					CREOSOT	BEEC E, 80%;	H TA	—(R,	*Con* 20%—	*tinu* (LO	*ed*). WR	Y).			
5.1							1916	4.	0					Ave. sapwood, 50%	8.10
						CR	U	DE	OIL.						
6.1	Yes		Cut	75	Gravel		1916	5.	0					No tie plates under joints	5.20
						J. M.	LO	NG'	S LIQ	UID.					
7.1	Economy			75	Dirt		1916	6.	100.00	100.00			4½	50% tie plated	12.11
						UN	TR	EAT	ED.						
8.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	96.40						5.20
8.2	"		90		Gravel		1916	6.	65.20						5.20
8.3	Yes		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	96.60						5.20
8.4	"		"	75-85-90	"		1916	6.	26.70						5.20
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
9.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	11.30						5.20
9.2	All		90		Cinders		1916	6.	1.00						5.20
9.3	Yes		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	1.70						5.20
9.4	"		"	90	Lyons Stone		1916	6.	0						5.20
9.5	None		Cut	90	Gravel	Heavy	1916	5.	0.20	0.20		94.4% Very Good		Steamed before treatment.	6.11
9.6							1916	4.	0					Treated ties stacked in open piles 26 days before setting. Ave. sapwood, 20%.	8.10
9.7							1916	4.	0					Ave. sapwood, 20%. Treated ties stacked in open piles 26 days before setting.	8.10
9.8	Sellers	6x8	Cut	90	Stone		1916	7.	24.10					Removed acct. derailment. Includes ash, elm, gum, chestnut and maple. 50% tie plated.	12.11

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
					ZINC	CHLOR	BEECH—IDE—(BUR	*(Continued).* NETT).					
9.9	6x8x8	Sawed Hewed	"	274				0.50	1910	I.C.	Bloomington, Ill.		
9.10	6x8x8	Sawed Hewed	"	274				0.50	1909	"	Fulton, Ky.		
9.11	6x8x8	Sawed Hewed	"	274				0.50	1910	"	Greenville, Miss.		
						ZINC-	CREOSOTE	—(CARD).					
10.1				433				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
10.2				370				Zn. 0.50 Cre. 3.00	1909	"	" "		
10.3				37				Zn. 0.50 Cre. 3.00	1911	"	" "		
10.4				240				Zn. 0.50 Cre. 3.00	1909	"	" West		
10.5				177				Zn. 0.50 Cre. 3.00	1910	"	" "		
10.6	7x9x8½	Sawed Hewed	Peeled Seasoned	1,107				Zn. 0.50 Cre. 2.00	1911	B.&O.	Windsor, O.		
10.7	6x8x8	Sawed	Seasoned 8 mos.	162	N. Wis	19 to Rl.	6.6	Zn. 0.50 Cre. 2.00	1912	C.M.& St. P.	Lake Wis.	Tang.	0
10.8	6x8x8			125				Zn. 0.50 Cre. 2.00	1908	C.&N.W.	St. Francis, Wis.		
						CR	BIR EOSOTE—((See Birch Index	CH. FULL-CEL No. 1.6).	L).				

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Service Conditions—*(Continued)*.							Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
						BEEC	H	—(	*Con*	*tinu*	*ed*).				
9.9	"	6x8	"	75	Gravel		1916	6.	0					Includes ash, elm, gum, chestnut and maple.	12.11
9.10	"	6x8	"	90	"		1916	7.	8.40		8.40			Includes ash, elm, gum, chestnut and maple. Worn out and split, badly creeping track. Badly checked and spikes worn. Includes ash, elm, gum, chestnut and maple.	12.11
9.11	"	6x8	"	75	Dirt Gravel since 1912		1916	6.	10.50					Badly checked and spike worn. 50% tie-plated. Includes ash, elm, gum, chestnut and maple.	12.11
					ZINC-CREOSO	TE—(C	AR	D).							
10.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	2.50						5.20
10.2	All		"	90	Sheridan Gravel		1916	7.	0						5.20
10.3	Yes		"	75	"		1916	5.	0						5.20
10.4	"		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	2.90							5.20
10.5	"		"	90	Lyons Stone		1916	6.	0						5.20
10.6	Shoulder Flanges		"	90	Gravel	Heavy	1916	5.	0			99.2% good		0.8% Decayed. Includes gum.	4.11
10.7	None		"	85	Cinder	Light	1916	4.	0			good		Sawed boxed heart.	6.11
10.8				90	Slag		1916	8.	2.40						48.00

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Cross-Tie Records—Service Tests—*(Continued).*

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption: Lbs. Per Tie	Average Absorption: Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
						CR	BIRCH—EOSOTE—(LOWRY.)	*(Continued).*					
						(See	Birch Index	No. 2.1).					
1.1	7x9x8	Hewed	Seasoned	49	Minn.	19 to Rl.	22.8	6.5	1908	N.P.	Sumner, Wash.	Tang.	
							BIRCH—(Red).						
						CR	EOSOTE—(	FULL-CEL	L).				
2.1				45					1910	C.B.&Q.	Hanover, Ill.		
2.2				30					1910	"	Blanding, Ill.		
2.3				14					1911	"	Baders, Ill.		
2.4				59					1910	"	Barr, Colo.		
							UNTRE	ATED.					
3.1				49					1910	C.B.&Q.	Lines East		
3.2				30					1910	"	Lines West		
						ZINC	CHLORIDE	—(BURNE	TT).				
4.1				73				0.5	1910	C.B.&Q.	Lines East		
4.2				30				0.5	1910	"	Barr, Colo.		
						ZINC-	CREOSOTE	—(CARD).					
5.1				433				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
5.2				276				Zn. 0.50 Cre. 3.00	1910	"	" "		
5.3				238				Zn. 0.50 Cre. 3.00	1909	"	" West		
5.4				122				Zn. 0.50 Cre. 3.00	1910	"	" "		

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Service Conditions—*(Continued)*.						Results.								
Index No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					BIRCH—(*Continued* (See Birch Index No. 2.1).		).								
					(See Beech Index No. 2.1).										
11.1	Flat	6x8¼x 9/16	Cut	85	Gravel	Heavy	1915	7.	0						19.00
						BIRCH—(Redwood).									
						CREOSOTE—(FULL-CELL).									
2.1	All		Cut	90	Sheridan Gravel		1916	6.	0						5.20
2.2	"		"	90	" "		1916	6.	0						5.20
2.3	Except under joints		"	75	Gravel		1916	5.	0						5.20
															5.20
2.4	Yes		"	90	Lyons Stone		1916	6.	0					Seasoned 1 year after treatment.	5.20
						UNTREATED.									
3.1	All		Cut	90	Sheridan Gravel		1916	6.	91.90						5.20
3.2	Yes		"	90	Lyons Stone		1915	5.	100.00				3.4		5.20
					ZINC CHLORIDE—(BURNETT).										
4.1	All		Cut	90	Sheridan Gravel		1916	6.	2.70						5.20
4.2	Yes		"	90	Lyons Stone		1916	6.	3.30					Seasoned 1 year after treatment.	5.20
					ZINC-CREOSOTE—(CARD).										
5.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	4.60						5.20
5.2	All		"	90	Gravel		1916	6.	0						5.20
5.3	Yes		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	0.40						5.20
5.4	"		"	90	Lyons Stone		1916	6.	0						5.20

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							BIRCH—	(Yellow).					
						ZINC	CREOSOTE	—(CARD).					
6.1	6x8x8			288				Zn. 0.50 Cre. 2.00	1908	C.&N.W.	St. Francis, Wis.		
							BIRCH—	(White).					
						ZINC	CREOSOTE	—(CARD).					
7.1	6x8x8			325				Zn. 0.50 Cre. 2.00	1908	C.&N.W.	St. Francis, Wis.		
							CATAL	PA.					
							UNTRE	ATED.					
1.1	7x8x8½	Hewed	Bored for S. Sp.	122	Ohio	17 to 33′			1907	Penn.	Urbana, O.	Tang.	0.7 down
1.2	7x8x8½	"	" " "	495	"	16 to 33′			1909	"	St. Paris, O.	Tang. & 2°	1.1 down
							CED	AR—(Nor	thern Wh	ite).			
							UNTRE	ATED.					
						(See Ta	marack Ind	ex No. 6.9	).				
1.1	7x8x8			965					1904	G.N.	Mohall, N. D.	Tang.	
1.2	7x7x8	Pole		500	Mich.	17 to Rl.			1902	C.M.& St.P.	Lynden, Wis.	"	1.0
1.3	6x6x8	Sawed faces		177	"	22 to Rl.			1911	"	Monroe, Wis.	"	0
1.4	6x6x8	Sawed faces		97	"	22 to Rl.			1913	"	"	"	0
1.5	6x6x8	Hewed		500	"	18 to Rl.			1912	"	Milwaukee, Wis.	"	0
1.6	6x6x8	"		500	"	18 to Rl.			1912	"	"	"	0
1.7	6x7x8	"		1,000	"	17 to Rl.			1914	"	Cranmoor, Wis.	"	0
1.8	6x7x8	"		1,000	"	17 to Rl.			1914	"	Merrill, Wis.	"	

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Refer-erence No.
						BIRC	H	—(	Yello	w).					
					ZINC-CREOSO	TE—(C	AR	D).							
6.1				90	Slag		1916	8.	1.00						48.00
						BIRC	H	—(	Whit	e).					
					ZINC-CREOSO	TE—(C	AR	D).							
7.1				90	Slag		1916	8.	0.90						48.00
						CA	TA	LP	A.						
						UN	TR	EAT	ED.						
1.1	Goldie	7x9	Screw	85	Gravel	11,000,000	1916	9.	34.00			Poor		Removed for decay and wear	20.11
1.2	Yes	7x10	"	85	"	11,000,000	1916	7½	41.00			"		Removed for decay and wear	20.11
					CEDAR—(	Norther	n	Wh	ite).						
						UN	TR	EAT	ED.						
1.1	None		9/16x 5½	68	Gravel	315,650	1916	12.	59.20	59.20					40.10
1.2	M. I.	4½x7½	Com.	85	"	Heavy	1916	14.	50.00		50.00			Removed because of rail-cut. Q. & C. tie plates until 1912.	6.11
1.3	None		"	60	Cinders	"	1916	5.	23.00			Fair		Removed because of de-rail—ties broken.	6.11
1.4	"		"	60	"	"	1916	3.	0			Good			6.11
1.5	Sellers	5x8	"	65	Gravel	"	1916	4.	0			"			6.11
1.6	None		"	65	"	Medium	1916	4.	0			"		Slightly rail-cut.	6.11
1.7	Sellers	5x8		85	Sand	Heavy	1916	2.	0			"		Most of these rail-cut to ¼ inch.	6.11
1.8	None			85	Clay & Gravel	"	1916	2.	0			"			6.11

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
						CEDA	R—Northe UNTRE	rn White ATED.	).—(	*Continu*	*ed).*		
1.9				1,000					1903	C.&N.W.	Elmhurst, Ill.		
1.10	6x8x8	Hewed		11,516					1900	C.R.I.&P.	Sibley, Ia.		
1.11	6x8x8	"		2,001					1898	"	Vinton, Ia.		
						CED	AR—(Wes	tern Red	).				
							UNTRE	ATED.					
1.1	7x7x8	Pole		445	Wash.	18 to Rl.			1913	C.M.& St.P.	Jefferson, S. D.	Tang.	
							CHERR	Y.					
						CR	EOSOTE—(	LOWRY.)					
1.1	6x8x8	Hewed	Seasoned	6	Ind.	20"	19.4	7.3	1914	C.I.&L.	Lafayette, Ind.	Tang.	0.5
							CHESTN	UT.					
						CR	EOSOTE—(	FULL-CEL	L).				
1.1	7x9x8½		Steamed	88					1907	D.&L.W.	Boonton, N. J.		
1.2	7x9x8½			95					1907	"	"		
						CR	EOSOTE—(	LOWRY.)					
2.1	7x9x8½			733			Gals. 3.5		1912	D.&L.W.	Paterson, N. J.		
						CR	EOSOTE—(	RUEPING	).				
						(See B	eech Index N	os. 3.2-3 4	).				

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Index No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					CEDAR—(Northern White)—(*Continued*). UNTREATED.										
1.9	50% Walhaupter 50% none	4x6		100	Stone		1916	13.	62.00					Rail is cutting into ties. Probably all will be removed next season.	48.00
1.10	None		Cut	60	Dirt, Gr. & Cin.	Light	1916	16.	17.10						36.00
1.11		$\frac{1}{4}$x5x7$\frac{1}{2}$	"	80	Gravel	4,745,000	1916	18.	69.60						36.00
						CERAD		—(Wes	tet						
						UNTR		EATED.							
1.1	Sellers	5x8	Cut	85	Gravel	Heavy	1916	3.	0			Excellent			6.11
							CHER	RY.							
						CREOSOTE		—(LOW	RY).						
1.1	Economy	7	Cut	90	Gravel	5,297,567	1916	2.	0			Excellent		Treated July, 1913.	51.00
						CHESTN	UT.								
					CR	EOSOTE	—(FUL	L-CE	LL).						
1.1	Walhaupter		Cut	101	Stone		1916	9.	0						44.10
1.2	"		"	101	"		1916	9.	0						44.10
						CREOSOTE		—(LOW	RY).						
2.1	D.L.&W.		Screw	101	Stone		1916	4.	0						44.10
						CREOSOTE		—(RUEP	ING).						
					(See	Beech Index		Nos.	3.2-3.4	).					

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Cross-Tie Records—Service Tests—*(Continued)*.

DESCRIPTION OF MATERIAL.									SERVICE CONDITIONS				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption: Lbs. Per Tie	Average Absorption: Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
3.1		Hewed	Seasoned	278		CHEFU	STNUT—EL OIL—(Gals. 2.26	(*Continued*). LOW-PRESSUR 6.7	1910	E). Picatinny Arsenal	Dover, N. J.		
4.1				165			UNTREATED.		1909	C.B.&Q.	Lines East		
4.2				90					1909	"	Lines West		
4.3	7x9x8½		Seasoned	16					1912	D.&L.W.	Paterson, N. J.		
5.1	6x8x8		Seasoned	23		ZINC (See 22 to Rl.	CHLORIDE Beech Index	—(BURNETT). Nos. 9.8-9.11 0.5	1911	). C.M.& St.P.	Hartford, Wis.	Tang.	0
6.1				165		ZINC-	CREOSOTE	—(CARD). Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
6.2				89				Zn. 0.50 Cre. 3.00	1909	"	Lines West		
1.1				85		CR	COTTON EOSOTE—(	WOOD. FULL-CEL 9.96	1909	L). C.B.&Q.	Lines East		
1.2				37				9.96	1909	"	Lines West		
2.1	7x9x8	Sawed	Seasoned	261	CREO Mont.	SOTE 16 to 30' Rail	20% REFIN 30	ED TAR— 8.6	1910	(LOW RY). N.P.	Rocky Mt. Div. Montana	Tang.	0
2.2	7x9x8	"	"	554	"	16 to 30' Rail	30	8.6	1910	"	Washington	"	0

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					CHESTNUT	—(Con	tin	ued	).						
					FUEL	OIL—(L	OW-	PR	ESSU	RE).					
3.1	Flat & Flange						1915	5.	0						22.00
						UN	TR	EAT	ED.						
4.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	43.00						5.20
4.2	Yes		"	75-85-90	"		1916	7.	26.70						5.20
4.3	D.L.&W.		Screw	101	Stone		1916	4.	0						44.10
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
					(S	ee Beech	Ind	ex	Nos.	9.8-9.	10).				
5.1	M.I.Rib., Fl.Steel	6x8	65% C. 35% S.	90	Gravel	Heavy	1916	5.	0			100% Good			27.00
					ZINC-CREOSO	TE—(C	AR	D).							
6.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	36.00						5.20
6.2	Yes		"	75-85-90	"		1916	7.	28.10						5.20
						CO	TT	ON	WO	OD.					
					CR	EOSOTE	—(	FUL	L-CE	LL).					
1.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	0						5.20
1.2	Yes		"	75-85-90	"		1916	7.	0						5.20
					CREOSOTE	20% REF	IN	ED	TAR	—(L	OW	RY).			
2.1			Cut	72	Dirt & Sand	Light	1915	5.	0			O. K.			19.00
2.2	Flat	6x8½x 9/16		72	" "	Heavy	1915	5.	0			"			19.00

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Cross-Tie Records—Service Tests—*(Continued)*.

DESCRIPTION OF MATERIAL.									SERVICE CONDITIONS				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
						COTT	ONWOOD	—(*Contin*	*ued*).				
							UNTRE	ATED.					
3.1				56					1909	C.B.&Q.	Lines East		
						ZINC	CREOSOTE	—(CARD).					
4.1				286				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
4.2				160				Zn. 0.50 Cre. 3.00	1909	"	Lines West		
							CYPRE	SS.					
						CR	EOSOTE—(	FULL-CEL	L).				
1.1				15					1910	C.B.&Q.	Hanover, Ill.		
1.2				10					1910	"	Blanding, Ill.		
1.3				29					1910	"	Barr, Colo.		
							CRUDE OIL.						
2.1				3					1911	C.B.&Q.	Baders, Ill.		
							UNTRE	ATED.					
3.1				114					1909	C.B.&Q.	Lines East		
3.2				25					1910	"	"		
3.3				60					1909	"	Lines West		
3.4				29					1910	"	" "		
3.5	7x8x9			500					1905	G.H.& S.A.	Bay View & San Leon		
3.6	7x8x9			500					1905	"	"		
3.7	7x9x8			2,290					1909	"	"		
3.8	7x9x8			3,637					1909	"	"		
3.9		Hewed		282					1895	"	Watkins, C. O.		
3.10		"		568					1895	"	" " "		
3.11		"		73					1895	"	" " "		
3.12		Sawed		374					1895	"	" " "		
3.13		"		654					1895	"	" " "		
3.14	7x9x9			6,675					1910	"	Lafayette and Scott		

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Index No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					COTTONWO	OD—(	*Con*	*tin*	*ued*).						
						UN	TR	EAT	ED.						
3.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1915	6.	100.00				2.6		5.20
					ZI	NC CRE	OS	OT	E—(C	ARD	).				
4.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	2.10						5.20
4.2	Yes		"	75-85-90	"		1916	7.	1.20						5.20
							CY	PR	ESS.						
					CR	EOSOTE	—(	FUL	L-CE	LL).					
1.1	All		Cut	90	Sheridan Gravel		1916	6.	0						5.20
1.2	"		"	90	" "		1916	6.	0						5.20
1.3	Yes		"	90	Lyons Stone		1916	6.	0						5.20
						CR	U	DE	OIL.						
2.1	Yes		Cut	75	Gravel		1916	5.	0					No tie-plates under joints	5.20
						UN	TR	EAT	ED.						
3.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	50.00						5.20
3.2	All		"	90	Gravel		1916	6.	32.00						5.20
3.3	Yes		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	80.00						5.20
3.4	"		"	90	Lyons Stone		1916	6.	6.90						5.20
3.5	Glendon				Gravel		1916	11.	31.80					24.9% account wreck	7.10
3.6	None				"		1916	11.	41.00					31.6% " "	7.10
3.7	Clark		Screw	80	"		1916	7.	0					5% decayed	7.10
3.8	"		"	80	"		1916	7.	0					5% "	7.10
3.9	Yes				Dirt		1916	21.	93.30						7.10
3.10	None				"		1916	21.	99.60						7.10
3.11	"				Earth		1916	21.	94.50						7.10
3.12	Yes				"		1916	21.	100.00				15.2		7.10
3.13	None				"		1916	21.	100.00				15.2		7.10
3.14	Clark		"	80	Gravel		1916	6.5	0			Good			7.10

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Cross-Tie Records—Service Tests—*(Continued)*.

DESCRIPTION OF MATERIAL.									SERVICE CONDITIONS				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							CYPRESS	—(*Continued*).					
						ZINC	CHLORIDE	—(BURNETTIZED).					
4.1				15				0.50	1910	C.B.&Q.	Hanover, Ill.		
4.2				10				0.50	1910	"	Blanding, Ill.		
4.3				30					1910	"	Barr, Colo.		
						ZINC	CREOSOTE	—(CARD).					
5.1				394				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	LinesEast		
5.2				24				Zn. 0.50 Cre. 3.00	1910	"	" "		
5.3				208				Zn. 0.50 Cre. 3.00	1909	"	Lines West		
5.4				47				Zn. 0.50 Cre. 3.00	1910	"	" "		
							CYPRESS	—(Red).					
							UNTREATED.						
6.1				274					1910	I.C.	Greenville, Miss.		
							CYPRESS	—(Yellow).					
							UNTREATED.						
7.1				274					1910	I.C.	Greenville, Miss.		
							ELM.						
						CR	EOSOTE—(	LOWRY.)					
1.1	7x9x8	Hewed	Seasoned	53	Minn.	19 to Rl.	22.8	6.50	1908	N.P.	Sumner, Wash.	Tang.	0
						CR	EOSOTE—(	RUEPING	).				
						(See	Beech, Index	Nos. 3.2-3.4	).				

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Indx No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. In-spected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					CYPRESS—	(*Contin	*ued*	).							
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
4.1	All		Cut	90	Sheridan Gravel		1916	6.	0						5.20
4.2	"		"	90	" "		1916	6.	0						5.20
4.3	Yes		"	90	Lyons Stone		1916	6.	0						5.20
					ZI	NC CRE	OS	OT	E—(C	ARD	).				
5.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	1.30						5.20
5.2	All		"	90	"		1916	6.	0						5.20
5.3	Yes		"	75-85-90	"		1916	7.	0.50						5.20
5.4	"			90	Lyons Stone		1916	6.	0						5.20
						CYP	RE	SS	—(R	ed).					
						UN	TR	EAT	ED.						
6.1	Economy			75	Dirt		1916	6.	0					50% tie-plated	12.11
						CYPRE	SS	—(	Yello	w).					
						UN	TR	EAT	ED						
7.1	Economy			75	Dirt		1916	6.	0.40	0.40				50% " "	12.11
							EL	M.							
						CREOSO	TE	—(	LOW	RY).					
1.1	Flat	6x8¼x 9/16	Cut	85	Gravel	Heavy	1915	7.	0			O. K.			19.00
						CREOSO	TE	—(R	UEP	ING).					
						(See Beec	h,	Inde	x Nos.	3.2-	3.4).				

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
							ELM—(*Continued*).						
						ZINC	CHLORIDE	—(BURNETT).					
						(See	Beech Index	Nos. 9.8-9.11	).				
							ELM—(	Hickory).					
						CREO	SOTE AND	TAR—(LOWRY).					
2.1	6x8x8	Sawed	Seasoned 10 mos.	68	Ark.		Gal. 2.55	7.57	1912	C.&E.I.	Tuscola, Ill.		
2.2	6x8x8	Hewed	Seasoned 10 mos.	1,288	"		Gal. 2.55	7.57	1912	"	"		
							ELM—(	White).					
						CR	EOSOTE—(	FULL-CEL	L).				
3.1				106				12.97	1909	C.B.&Q.	Lines East		
3.2				99				12.97	1909	"	" "		
3.3				58				12.97	1909	"	Lines West		
3.4				60				12.97	1910	"	" "		
						CR	EOSOTE—(	LOWRY.)					
	6x8x8	Hewed Sawed	Seasoned	200	Ind.	20"	23.3	8.7	1914	C.I.&L.	Lafayette, Ind.	Tang.	0.5
							CRUDE OIL.						
4.1				2					1911	C.B.&Q.	Baders, Ill.		
							UNTRE	ATED.					
5.1				89					1909	C.B.&Q.	Lines East		
5.2				25					1910	"	" "		
5.3				48					1909	"	Lines West		
5.4				30					1910	"	" "		

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Service Conditions—*(Continued)*.							Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
						ELM	—(	*Con*	*tinue*	*d*).					
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
						(See Beec	h,	Inde	x Nos.	9.8-	9.11	).			
						ELM	—(	Hic	kory	).					
						CREOSO	TE	—(	LOW	RY).					
2.1							1916	4.	0					20% tar and 80% creosote. Ave. sapwood, 60%.	8.10
2.2							1916	4.	0					20% tar and 80% creosote. Ave. sapwood, 60%.	8.10
						EL	M	—(	Whit	e).					
					CR	EOSOTE	—(	FUL	L-CE	LL).					
3.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	2.80						5.20
3.2	All		"	90	Gravel		1916	7.	4.00						5.20
3.3	Yes		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	0						5.20
3.4	"		"	90	Lyons Stone		1916	6.	0						5.20
						CREOSO	TE	—(	LOW	RY).					
	Economy	7	Cut	90	Gravel	5,297,567	1916	2.	0			Excellent		Treated July, 1913, placed June, 1914.	51.00
						CR	U	DE	OIL.						
4.1	Yes		Cut	75	Gravel		1916	5.	0					No tie-plates under joints.	5.20
						UN	TR	EAT	ED.						
5.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	93.20						5.20
5.2	All		"	90	Sheridan Gravel		1916	6.	76.00						5.20
5.3	Yes		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	100.00				5.1	All out in 7 years.	5.20
5.4	"		"	90	Lyons Stone		1916	6.	43.30						5.20

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
						EL	M(—White	)—(*Conti*	*nued*	).			
						ZINC	CHLORIDE	—(BURNE	TT).				
6.1				77				0.50	1909	C.B.&Q.	Lines East		
6.2				146				0.50	1910	"	" "		
6.3				43				0.50	1909	"	Lines West		
6.4				30				0.50	1910	"	" "		
						ZINC	CREOSOTE	—(CARD).					
7.1				444				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
7.2				195				Zn. 0.50 Cre. 3.00	1908	"	" "		
7.3				149				Zn. 0.50 Cre. 3.00	1910	"	" "		
7.4				165				Zn. 0.50 Cre. 3.00	1910	"	Chicago, Ill.		
7.5				244				Zn. 0.50 Cre. 3.00	1909	"	Lines West		
7.6				121				Zn. 0.50 Cre. 3.00	1910	"	" "		
7.7	6x8x8			76				Zn. 0.50 Cre. 2.00	1908	C.&N.W.	St. Francis, Wis.		
						FI	R—(DOUG	LAS—CO	AST	).			
							CARBOL	INEUM.					
1.1	7x9x8	Sawed	Sun dried 90 days	300	Oregon or Wn.	18 to Rl.		1.2	1908	O.W.R. &N.C.	Dodson, Ore.	Tang.	
							CREO	SOTE.					
2.1		Hewed		2,938	Coast			12.0	1911	G.N.	Butte Div.	Tang. 70% Curve 30%	
2.2		Sawed		3,453	"			12.0	1911	"	Butte, Div.	Tang. 70% Curve 30%	

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Indx No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					EL	M—(W	hit	e)	—(C	*onti*	*nue*	*d*).			
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
6.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	5.20						5.20
6.2	All		"	90	Sheridan Gravel		1916	6.	1.40						5.20
6.3	Yes		"	75-85-90	Cin.,Gr., Bt. Cl.		1916	7.	0						5.20
6.4	"		"	90	Lyons Stone		1916	6.	0						5.20
					ZI	NC CRE	OS	OT	E—(C	ARD	).				
7.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	1.40						5.20
7.2	"		"	90	Gravel		1916	8.	1.00					Tie-plates on curves.	5.20
7.3	All		"	90	"		1916	6.	0.70						5.20
7.4	None		"	66	Piling Driven in Sand		1916	6.	0			Fine			5.20
7.5	Yes		"	75-85-90	Cin., Gr., Cl. St		1916	7.	2.00						5.20
7.6	"		"	90	Lyons Stone		1916	6.	0						5.20
7.7	None		"	90	Slag		1916	8.	0					Mechanical wear ¼ to 1 in.	48.00
					FIR	—(DO	UG	LA	S—C	OA	ST	).			
					CARBOLI	NEUM.									
1.1		8x8½	Cut	75	Gravel	6,000,000	1916	8	1.70	1.70		Good			28.00
					CREOSOTE.										
2.1	Goldie G. 58	6x8½	⅝x6	G. N. 90	Gravel Av. 10"		1916	5⅛	59.00			V. Poor		Removed acct. check and split. Ties are crushing and checking.	40.10
2.2	J. G. 58 "	6½x8½ 6½x8½	⅝x6	G. N. 90	"		1916	5⅛	27.00			"		Removed acct. check and split. Ties are crushing and checking.	40.10

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
				FI	R—(	DOU	GLAS—C	OAST)—	(*Conti*	*inued*).			
							CREOSOTE.						
2.3		Sawed		1,000	Oregon or Wash.	18 to Rl.		8.0	1908	O.W.R. &N.C.	Dodson, Ore.	1% Curve partly on Tangent .35% grade	
						CR	EOSOTE—(	BOILING)					
3.1				527	Coast				1911	N.P.	Seattle, Wash.		
						CR	EOSOTE—(	FULL-CEL	L).				
4.1	7x9x8	Sawed	Seasoned	173	"			6.2	1906	N.P.	Maywood, Wash.		
4.2	7x9x8	"	"	46	"			6.2	1906	"	" "		
4.3	7x9x8	"	"	100	"			6.2	1906	"	" "		
4.4	7x9x8	"	"	71	"			6.2	1906	"	" "		
4.5	7x9x8	"	"	52	"			6.2	1906	"	" "		
						CR	EOSOTE—(	RUEPING).					
5.1				519	"			12.0	1911	N.P.	Seattle, Wash.		
						CRE	OSOTE AND	CRUDE O	IL.				
6.1				156	"			12.0	1911	N.P.	Seattle, Wash.		
							UNTRE	ATED.					
7.1	7x8x8	Sawed	Seasoned	137	Wash Coast				1911	C.M.& St.P.	McGregor Ia.		

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Service Conditions—*(Continued)*.						Results.									
Index No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					FIR—(DOU CREOSOTE.	GI.AS	—C	OA	ST)	—(C	onti	nued).			
2.3		8x8½	Cut	C. S. Sect. 75	Gravel replaced with crushed rock Jan. 1914	6,000,000	1916	8.	0.20			Good		Gravel ballast replaced with crushed rock in Jan., 1914.	28.00
						CREOSO	TE	—(B	OILI	NG).					
3.1							1915	4.	0					Usual softening and cutting.	19.00
					CR	EOSOTE	—(	FUL	L-CE	LL).					
4.1	Sellers	6 3/16x 8¼	Cut	85	Gravel	Heavy	1916	10.	23.00		23.00	Fair		Practically all ties not re-	25.00
4.2	"	6 3/16x 8¼	Cut & Screw	85	"	"	1916	10.	20.00		20.00	"		moved were turned in	25.00
4.3	"	6 3/16x 8¼	Screw	85	"	"	1916	10.	9.00		9.00	"		1916 relaid with 90 lb.	25.00
4.4	None		Cut	85	"	"	1916	10.	7.00		7.00	"		steel N. P. standard tie-	25.00
4.5	Sellers	6 3/16x 8¼	"	85	"	"	1916	10.	0			"		plates and cut spikes.	25.00
						CREOSO	TE	—(R	UEP	ING).					
5.1							1915	4.	0					Usual softening and cutting.	19.00
					CR	EOSOTE	AN	D C	RUD	E OI	L.				
6.1							1915	4.	0					80% crude oil, 20% creosote. Usual softening and cutting.	19.00
							UN	TR	EAT	ED.					
7.1	None		Cut	65	Cinder	Average	1916	5.	0			Fair		94.9% good; 5.1% decayed	6.11

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
				FI	R—(	DOU	GLAS—C	OAST)—	(*Cont*	*inued*).			
							UNTREA	TED.					
7.2	7x8x8	Sawed		500	Wash. Coast				1912	C.M.& St.P.	Groton, S.D.	Tang.	
7.3	7x9x8	"	Sun dried 90 days Seasoned	1,006	Ore. or Wash. Coast	18 to Rl.			1908	O.W.Ry. &N.Co.	Dodson, Ore.	"	
7.4	7x9x8	"	Not Seasoned	1,007	Ore. or Wash. Coast	18 to Rl.			1908	"	Dodson, Ore.	"	
7.5	7x9x8	"	Green	264	Ore. or Wash. Coast				1906	N.P.	Maywood, Wash.		
7.6	7x9x8	"	"	46	Ore. or Wash. Coast				1906	"	" "		
7.7	7x9x8	"	"	47	Ore. or Wash. Coast				1906	"	" "		
7.8	7x9x8	"	"	100	Ore. or Wash. Coast				1906	"	" "		
7.9	7x9x8	"	"	100	Ore. or Wash. Coast				1906	"	" "		
7.10	7x9x8	"	Seasoned	100	Ore. or Wash. Coast				1906	"	" "		
7.11	7x9x8	"	Seasoned	58	Ore. or Wash.				1906	"	Maywood, Wash.		
7.12	7x9x8	"	"	96	Ore. or Wash.				1906	"	" "		
7.13	7x9x8	"	"	91	Ore. or Wash.				1906	"	" "		

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Service Conditions—*(Continued)*.						Results.							
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					FIR—(DOU	GLAS	—C	OA	ST)	—(*C*	*onti*	*nued*).			
					UNTREATED.										
7.2	Sellers Applied 1914-5x8	5x8	Cut	90	Cinder	Heavy	1916	4.	0					2.4% rotten on top.	6.11
7.3		8x8½	"	C. S. Sect. 75	Gravel	6,000,000	1916	8.	15.50	15.50		30% show surface decay		Gravel replaced by crushed rock, Jan., 1914.	28.00
7.4		8x8½	"	C. S. Sect. 75	"	6,000,000	1916	8.	21.45			Fair		Removed acct. checking and decay.	28.00
7.5	Sellers		"	85	"	Heavy	1916	10	88.00			Bad		90 lb. steel in 1916, cut spike and N. P. tie-plates.	25.00
7.6	"		C. & S.	85	"	"	1916	10	98.00			"		90 lb. steel in 1916, cut spike and N. P. tie-plates.	25.00
7.7	"		"	85	"	"	1916	10	98.00			"		90 lb. steel in 1916, cut spike and N. P. tie-plates.	25.00
7.8	"		"	85	"	"	1916	10.	89.00			"		90 lb. steel in 1916, cut spike and N. P. tie-plates.	25.00
7.9	None		Cut	85	"	"	1916	10	100.00				7.5	90 lb. steel in 1916, cut spike and N. P. tie-plates.	25.00
7.10	Sellers		C. & S.	85	"	"	1916	10	86.00			"		90 lb. steel in 1916, cut spike and N. P. tie-plates.	25.00
7.11	None		Screw	85	"	"	1916	10	97.00			"		90 lb. steel in 1916, cut spikes and N. P. tie plates.	25.00
7.12	Sellers		"	85	"	"	1916	10	89.00			"		90 lb. steel in 1916, cut spikes and N. P. tie plates.	25.00
7.13	"		C. & S.	85	"	"	1916	10	85.00			10% bad 5% fair or poor		90 lb. steel in 1916, cut spikes and N. P. tie plates.	25.00

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Cross-Tie Records—Service Tests—*(Continued)*.

DESCRIPTION OF MATERIAL.									SERVICE CONDITIONS				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
				FI	R—(	DOU	GLAS—C	OAST)—	*(Cont*	*inued).*			
							UNTRE	ATED.					
7.14	7x9x8	Sawed	Seasoned	350	Ore. or Wash.				1906	N.P.	Maywood, Wash.		
7.15	7x9x8	"	"	99	Ore. or Wash.				1906	"	" "		
7.16	7x9x8	"	"	284	Ore. or Wash.				1906	"	" "		
						ZINC	CHLORIDE	—(BURNE	TT).				
8.1	7x9x8	"	Sun dried 90 days	977	Ore. or Wash. Coast	18 to Rl.		0.25	1908	O.W.Ry. &N.Co.	Dodson, Ore.	Tang.	
8.2	7x9x8	"	Not Seasoned	975	Ore. or Wash. Coast	18 to Rl.		0.25	1908	"	"	"	
8.3	7x9x8	Hewed	Sun dried 6 mos.	1,969	Ore. or Wash. Coast	18 to Rl.		0.25	1908	"	"	"	
8.4				45 mi.	Coast				1903	S.P.	Nevada		
8.5				36 "	"				1903	"	"		
8.6				18 "	"				1903	"	Utah		
8.7				20 "	"				1903	"	Beppo, Utah		
8.8				6 "	"				1903	"	Loy, Utah		
8.9				46 "	"				1903	"	Hogup, Utah		
8.10				3 "	"				1903	"	Odgen, Utah		

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					FIR—(DOU	GLAS	—C	OA	ST)	—(C	onti	nued).			
					UNTREATED.										
7.14	Sellers		Cut	85	Gravel	Heavy	1916	10	93.00			5% good 2% poor		90 lb. steel in 1916, cut spikes and N. P. tie plates.	25.00
7.15	None		"	85	"	"	1916	10	97.00			Bad		90 lb. steel in 1916, cut spikes and N. P. tie plates.	25.00
7.16	Sellers		"	85	"	"	1916	10	90.00			"		90 lb. steel in 1916, cut spikes and N. P. tie plates.	25.00
					ZINC CHLOR	IDE—(B	UR	NET	T).						
8.1		8x8½	Cut	C. S. Sect. 75	Gravel	6,000,000	1916	8	4.30	4.30		Generally Sound		Gravel ballast removed in 1914, and crushed rock placed 1914.	28.00
8.2		8x8½	"	C. S. Sect. 75	"	6,000,000	1916	8	4.00	4.00		Good		Gravel ballast replaced with crushed rock in 1914.	28.00
8.3		8x8½	"	C. S. Sect. 75	"	6,000,000	1916	8	1.26	1.26		"		Gravel ballast replaced with crushed rock in 1914.	28.00
8.4	Wal-haupter						1916	13	100.00				10-11	1219 still in, Oct., 1916, but to come out within 6 months.	32.10
8.5	"						1916	13	100.00				10-11		32.10
8.6							1916	13	93.00			Decayed and checked		Ties remaining are decayed on bottom and ends with checks on top.	32.10
8.7							1916	13	90.00			Decayed		Show rot on bottom and ends.	32.10
8.8							1916	13	96.00			Decayed and checked		Decayed and checked. Removed acct. breaking.	32.10
8.9							1916	13	40.00			Good		Those across Great Salt Lake show no rot.	32.10
8.10	"						1916	13	98.00			Decayed			32.10

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
				FI	R—(	DOU	GLAS—C	OAST)—	(*Cont*	*inued*).			
						ZINC C	HLORIDE A	ND CRUD	E OIL.				
9.1	7x8x8	Sawed	Seasoned-Not bor. for spikes	93	Oregon Coast	23" Centers	Zn.Ch. .78 Crd.O. 11.95	Z. Ch. .25 Crd. 3.84 O.	1906	S.P.	Tracy, Cal.	Tang. level	
9.2	7x9x8	"	Unseasoned	140	Ore. & Cal. C.	18 to Rl.	Fir Zn.Ch. .2503 Crd.O. 7.25 W. Y. Pine Zn.Ch. 1.074 Crd.O. 16.83	.0718 2.07 .307 4.81	1906	"	Arbuckle, Cal.	"	0
						FIR—	(DOUGLA	S—MOU	NTAI	N).			
						CR	EOSOTE—(	FULL-CEL	L).				
10.1	7x8x8	Hewed		224	Mts.	19 to 33'		2.750	1910	B.A.&P.	Butte, Mont.	Tang.	
10.2	7x9x8	Hewed Sawed	Seasoned	74	Mont.			7.456	1905	C.B.&Q.	Elsberry, Mo.	"	
				C	REO	SOTE	—STEAMIN	G—(BET	HELL	).			
11.1	7x8x8	72% Hewed	Seasoned 14 mos.	50	Mont. & Ida.	19 to 33'	19.3	6.200	1915	N.P.	Thompson Falls, Mont.	2° Curve	0.30
11.2	7x8x8	87% Hewed	Seasoned 14 mos.	100	Mont. & Ida.	19 to 33'	19.3	6.200	1915	"	Thompson Falls, Mont.	1° Curve	0.30
11.3	7x8x8	81.3% Hewed	Seasoned 14 mos.	150	Mont. & Ida.	19 to 33'	19.3	6.200	1915	"	Thompson Falls, Mont.	1° Curve	0.36
11.4	7x8x8	97.9% Hewed	Seasoned 14 mos.	95	Mont. & Ida.	19 to 33'	19.3	6.200	1915	"	Thompson Falls, Mont.	1° Curve	0.36
						CRE	OSOTE—(O	PEN-TAN	K).				
12.1	7x9x8	Sawed Hewed	Seasoned	2	Mont			1.990	1905	C.B.&Q.	Elsberry, Mo.	Tang.	

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Service Conditions—*(Continued)*.						Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					FIR—(DOU ZINC	GLAS CHLORI	—C DE	OA AN	ST) D CR	—(C UDE	*onti* OIL.	*nued*).			
9.1	Ribbed	4½x8	Cut	80	Dirt & Gravel	Very Heavy	1916	10	30.10			Sound		Removed acct. changes in track and rail cut.	32.10
9.2	Rib. to 1915 Changed to Sacto	4½x8 8x9	"	90	Gravel	"	1916	10	2.80			54.3% Sound 42.8% Partly decayed		Removed acct rail cut. Douglas fir ties all decayed. (Includes W. Yellow Pine.)	32.10
					FIR—(CR	DOUG EOSOTE	LA —(	S— FUL	MO L-CE	UN LL).	TAI	N).			
10.1	Goldie	5x7	Cut	90	Rock	Heavy cars but not many	1916	6.0	0			Sound			24.00
10.2	Sellers		"				1916	11.2	5.6			81% O. K. 13.4% rail worn			5.20
					CREOSOTE—	STEAMI	NG	—(B	ETH	ELL	).				
11.1	N.P.Std.	7x9	Cut	90	Gravel	8,270,506	1916	1.0	0			Good			25.00
11.2	Vignoles bolted to	Rail Ch ties	airs	90	"	8,270,506	1916	1.0	0			"			25.00
11.3	N.P.Std.	7x9	"	90	"	8,270,506	1916	1.0	0			"			25.00
11.4	Vignoles bolted to	Rail Ch ties	airs	90	"	8,270,506	1916	1.0	0			"			25.00
					CREOSOTE—(	OPEN-T	AN	K).							
12.1	Sellers		Cut				1916	11.2	9.4			68.7% good 21.9% rl. cut			5.20

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
				FIR—	(DO	UGLA	S—MOUN	TAIN)—	(*Cont*	*inued*).			
						CR	EOSOTE—(	RUEPING	).				
13.1	7x9x8	Sawed Hewed	Seasoned	40	Mont.			5.775	1905	C.B.&Q.	Elsberry, Mo.	Tang.	
							UNTRE	ATED.					
						(See Ta	marack Index	Nos. 6.5-6.7	).				
14.1	7x9x8	Hewed	Green	95	"	18 to Rl.			1907	N.P.	Plains, Mont.	Tang.	0.017
14.2	7x9x8	"	"	108	"	18 to Rl.			1907	"	" "	"	0.017
14.3	7x9x8	"	Seasoned	32	"	18 to Rl.			1907	"	" "	"	0.017
14.4	7x9x8	"	"	90	"	18 to Rl.			1907	"	" "	"	0.017
14.5	7x9x8	"	"	90	"	18 to Rl.			1907	"	" "	"	0.017
14.6	7x9x8	"	"	90	"	18 to Rl.			1907	"	" "	"	0.017
14.7	7x9x8	"	"	90	"	18 to Rl.			1907	"	" "	"	0.017
14.8	7x9x8	"	"	90	"	18 to Rl.			1907	"	" "	"	0.017
14.9	7x9x8	"	"	89	"	18 to Rl.			1907	"	" "	"	0.017
14.10	7x9x8	"	Green	92	"	18 to Rl.			1907	"	" "	"	0.017
14.11	7x8x8	6% Hewed	Seasoned 14 mos.	50	Mont. & Ida.	19 to Rl.			1915	"	Thompson Falls	2° Curve	0.30
14.12		Sawed Triangular		856	Mts.				1911	G.N.	Butte Div.	70% Tang.	
14.13		Slabbed		1,340	"				1911	"	"	70% Tang.	
14.14	7x9x8	Hewed Sawed	Seasoned	89	Mont.				1905	C.B.&Q.	Elsberry, Mo.	Tang.	
						ZINC	CHLORIDE	—(BURNE	TT).				
			(See Pine	Index	Nos. 4	1.8-41.1	0; Spruce Ind	ex No. 5.1;	Tamara	ck Index	7.6 and 7.8).		
15.1	7x9x8	Sawed	Partly Seasoned	90	Mts.	18 to Rl.		0.651	1907	N.P.	Plains, Mont.	Tang.	0.017

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
	SERVICE CONDITIONS—*(Continued)*.						RESULTS.								
				F	IR—(DOUGL	AS—M	O	UN	TAI	N)—	(*Co*	*ntinued*).			
						CREOSO	TE	—(R	UEP	ING).					
13.1	Sellers		Cut				1916	11.2	0			67% good 30% rl. worn 3% doty			5.20
						UN	TR	EAT	ED.						
					(See	Tamarac	k I	ndex	Nos.6.	5-6.7	).				
14.1	Wal-haupter & Sellers		S. & C.	85	Gravel	8,270,506	1916	9.3	100.00				7.6		25.00
14.2	Sellers		"	85	"	8,270,506	1916	9.3	100.00				7.6		25.00
14.3	Wood		"	85	"	8,270,506	1916	9.3	100.00				7.7		25.00
14.4	Wal-haupter		Cut	85	"	8,270,506	1916	9.3	100.00				7.7		25.00
14.5	Wal-haupter Sellers		"	85	"	8,270,506	1916	9.3	100.00				7.7		25.00
14.6	"		"	85	"	8,270,506	1916	9.3	100.00				7.7		25.00
14.7	"		C. & S.	85	"	8,270,506	1916	9.3	100.00				7.7		25.00
14.8	"		Screw	85	"	8,270,506	1916	9.3	100.00				7.7		25.00
14.9	N.P. 21		Cut	85	"	8,270,506	1916	9.3	100.00				7.7		25.00
14.10	Sellers		"	85	"	8,270,506	1916	9.3	100.00				7.6		25.00
14.11	N.P.Std.		"	90	"	8,270,506	1916	1.0	0			Good			25.00
14.12	Goldie	6x8½	"	90	"		1916	5.3	0			"			40.10
14.13	"	6x8½	"	90	"		1916	5.3	4.0	4.0		Poor			40.10
14.14	Sellers		"				1916	11.2	53.0			37% O. K. 7% rl. worn 3% doty			5.20
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
		(See P	ine Ind	ex Nos	41.8-41.10 Spruc	e Index N	o.5.	1 an	d Ta	mara	ck In	dex Nos. 7.	6 a	nd 7.8).	
15.1	Sellers		Screw	85	Gravel	8,270,506	1916	9.3	6.7		6.7	70% Good		22.2% turned over.	25.00

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
				FIR—	(DO	UGLA	S—MOUN	TAIN)—	*(Cont*	*inued).*			
					ZINC	CHLOR	IDE—(BUR	NETT).					
15.2	7x9x8	Sawed	Partly Seasoned	107	Mts.	18 to Rl.		0.651	1907	N.P.	Plains, Mont.	Tang.	0.017
15.3				3,202	"			0.500	1914	C.B.&Q.	Douglas, Wyo.		
15.4				3,120	"				1906	"	Kane, Wyo.		
15.5				3,121	"			0.500	1914	"	Arw Jct., Wyo.		
15.6	7x9x8	Sawed Hewed	Seasoned	91	Mont.			0.262	1905	"	Ellsberry, Mo.		
15.7		Sawed Triangular		1,635	Mts.			0.500	1911	G.N.	Butte Div.	70% Tang.	
15.8		Sawed		881	"			0.500	1911	"	"	70% Tang.	
15.9		Slabbed		1,286	"			0.500	1911	"	"	70% Tang.	
15.10		Sawed Triangular		1,984	"			0.750	1911	"	"	70% Tang.	
15.11		Sawed		819	"			0.750	1911	"	"	70% Tang.	
15.12		Slabbed		1,217	"			0.750	1911	"	"	70% Tang.	
						ZINC C	REOSOTE—	(ALLARD	YCE).				
16.1	7x9x8	Sawed Hewed	"	41	"			Zn. 0.29 Cre. 1.47	1905	C.B.&Q.	Elsberry, Mo.	Tang.	
						FIR—	(WHITE—	Grandis).					
						CR	EOSOTE—(	LOWRY.)					
1.1	7x8x8	Hewed	Seasoned 6-9 mos.	50	Mont. & Ida.	19 to 33'	28.5	9.13	1915	N.P.	Thompson Falls, Mont.	2° Curve	0.3
1.2	7x8x8	"	Seasoned 6-9 mos.	51	Mont. & Ida.	19 to 33'	28.5	9.13	1915	"	Thompson Falls, Mont.	2° Curve	0.4
1.3	7x8x8	"	Seasoned 6-9 mos.	49	Mont. & Ida.	19 to 33'	28.5	9.13	1915	"	Thompson Falls, Mont.	Tang.	0.4
1.4	7x8x8	"	Seasoned 6-9 mos.	50	Mont. & Ida.	19 to 33'	28.5	9.13	1915	"	Thompson Falls, Mont.	"	0.4

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Refer-ence No.
				F	IR—(DOUGL	AS—M	O	UN	TAI	N)—	(*Co*	*ntinued*).			
				ZINC	CHLORIDE—(	BURNE	TT	).							
15.2	Sellers		S. & C.	85	Gravel	8,270,506	1916	9.3	7.5		7.5	72.9% Good		19.6% Turned over.	25.00
15.3	Plated		Cut	90			1916	2.0	0					0.01% broken.	5.20
15.4	None		"	65	"		1916	10.0	0.03			Good			5.20
15.5	Plated		"	90			1916	2.0	0			"			5.20
15.6	Sellers		"		"		1916	11.2	14.3			58.2% good 27.5% rail worn			5.20
15.7	Goldie	6x8½	"	90	"		1916	5.3	0			Good		4% solution.	40.10
15.8	"	6x8½	"	90	"		1916	5.3	0			"		4% "	40.10
15.9	"	6x8½	"	90	"		1916	5.3	0			"		4% "	40.10
15.10	"	6x8½	"	90	"		1916	5.3	0			"		6% "	40.10
15.11	"	6x8½	"	90	"		1916	5.3	0			"		6% "	40.10
15.12	"	6x8½	"	90	"		1916	5.3	1.0			"		6% "	40.10
				ZINC	CREOSOTE-(A	LLARD	YC	E).							
16.1	Sellers		Cut				1916	11.2	14.6			61% good 22% rl. worn 2.4% doty			5.20
					FIR—(White	—Grand	is).								
						CREOSO	TE	—(	LOW	RY).					
1.1	N.P.Std.	7x9	Cut	90	Sand and Gravel	8,270,506	1916	1.	0			Good			25.00
1.2	Vignoles bolted to	Rail Ch	airs	90	"	8,270,506	1916	1.	0			"			25.00
1.3	Vignoles bolted to	Rail Ch	airs	90	"	8,270,506	1916	1.	0			"			25.00
1.4	N.P.Std.	7x9	"	90	"	8,270,506	1916	1.	0			"			25.00

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							GUM.						
						CR	EOSOTE—(	FULL-CEL	L).				
						(See	Beech Index	No. 1.5).					
						CR	EOSOTE—(	RUEPING	).				
						(See	Beech Index	Nos. 3.1-3.4	).				
1.1		Sawed	Seasoned	390				5.00	1907	A.T.& S.F.	Hutchinson, Kan.		
1.2		"	"	230				5.00	1907	"	Plevna, Kan.		
1.3		"	"	262				5.00	1907	"	Hutchinson		
1.4		"	"	14,497				5.00	1910	"	Cut-off		
						ZINC	CHLORIDE	—(BURNE	TT).				
						(See	Beech Index	Nos. 9.8-9.11	).				
2.1	6x8x8	"	Seasoned 8 mos.	8	Ky.		1.58	5.92	1912	C.&E.I.	Tuscola, Ill.		
2.2	6x8x8	Hewed	Seasoned 8 mos.	345	"		1.58	5.92	1912	"	"		
						ZINC	CREOSOTE	—(CARD).					
						(See	Beech Index	No. 10.6).					
						ZINC-	TANNIN—(	WELLHO	USE).				
3.1		"	Seasoned	100			4.22		1897	N.S.	Norfolk, Va.	Tang.	
3.2		"	"	25					1897	"	"	2° Curve	
3.3		Sawed		100			1.36		1897	"	"	Tang.	
							GUM—	(Red).					
							CREO	SOTE.					
						(See Oa	k Index No.	15.1 and 1	7.3).				

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Indx No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
						GUM.									
					CR	EOSOTE	—(	FUL	L-CE	LL).					
						(See Bee	ch I	ndex	No. 1.	5).					
						CREOSO	TE	—(R	UEP	ING).					
						(See Bee	ch I	ndex	Nos. 3.	1-3.4).					
1.1	Yes	7½x9	Cut	90	Rock	4.904,181	1916	9.	2.6	1.0	1.6				45.10
1.2	"	7½x9	"	85	Cinders	3,003,686	1916	9.	0						45.10
1.3	"	7½x9	"	90	Rock	4,904,181	1916	9.	1.1		1.1				45.10
1.4	"	7½x9	Screw	90	"	4,904,181	1916	6.	0						45.10
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
						(See Beec	h,	Inde	x Nos.	9.8-	9.11	).			
2.1							1916	4.	0					No steaming, 75% sap.	8.10
2.2							1916	4.	0					" " 75% "	8.10
					ZINC-CREOSO	TE—(C	AR	D).							
						(See Bee	ch I	ndex	No. 10.	6).					
					ZINC-TANNIN	—(WEL	LH	OUS	E).						
3.1	Servis		Cut	70	Gravel		1916	19.	58.0					Started to fail in 1907.	16.10
3.2	"		"	70	"		1916	19.	80.0					" " " " 1907.	16.10
3.3	"		"	70	"		1916	19.	77.0					" " " " 1905.	16.10

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Index No.	Dimensions	Form	Preparation	No. of Ties in Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
						GUM CREO	—(Red)— SOTE—(BE (See Oak Ind	(*Continued*). THELL). ex 12.1).					
						CR	EOSOTE—(	FULL-CEL	L).				
4.1				85				9.83	1909	C.B.&Q.	Lines East		
4.2				48				9.83	1909	"	" West		
4.3	6x8x8	Sawed		28			33.3	12.52	1905	G.H.& S.A.	Bay View, Tex.		
4.4	6x8x8	"		39			33.3	12.52	1905	"	"		
4.5	6x8x8	"		45			33.3	12.52	1905	"	"		
4.6	6x8x8	"		26			38.45	14.45	1905	"	"		
4.7	6x8x8	"		29			38.45	14.45	1905	"	"		
4.8	6x8x8	"		33			38.45	14.45	1905	"	"		
							CREOSOTE (See Oak Ind	—GIUSSA ex 14.1).	NI).				
5.1				18					1905	St.L.& S.F.	Pacific, Mo.		
						CR	EOSOTE—(	REUPING	).				
6.1	6x8x8	"	Seasoned 2 years	321			9.8		1906	St.L.& S.F.	St. Clair, Mo.	Tang.	
						DIAM	OND WOOD	PRESERV	ER.				
7.1	7x9x8	Hewed		500			Gal. 0.73	Gal. 0.21	1907	G.H.& S.A.	Ft. Hancock		
							UNTRE	ATED.					
8.1				100					1909	C.B.&Q.	Lines East		
8.2				54					1909	"	" West		

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Service Conditions—*(Continued)*.						Results.									
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
						CREOSO	TE	—(B	ETHE	LL).					
						(See	Oak	Inde	x 12.1	).					
					CR	EOSOTE	—(	FUL	L-CE	LL).					
4.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	1.2						5.20
4.2	Yes		"	75-85-90	"		1916	7.	2.1						5.20
4.3			Screw				1916	11.	47.8					Started to fail in 1908.	7.10
4.4	Glendon						1916	11.	33.3					" " " " 1912.	7.10
4.5	None						1916	11.	53.3					" " " " 1912.	7.10
4.6			"				1916	11.	7.7					No Steaming.	7.10
4.7	Glendon						1916	11.	17.2					" "	7.10
4.8	None						1916	11.	24.2					" "	7.10
					CR	EOSOTE	—(	GIU	SSAN	I).					
						(See Oak	Ind	ex	No. 14	.1).					
5.1							1916	11.	33.3					Incomplete record. Includes red oak.	30.20
						CREOSO	TE	—(R	UEP	ING).					
6.1	Yes	8¾x6¾	Cut	75-85	Gravel	8,300,000	1916	10.	0.3			Good		Tie-plated 1914. Rail changed 1909. Gravel on cinders in 1914.	30.20
					DIA	MOND	WO	OD	PRES	ERV	ER.				
7.1	Glendon		Cut		Slag		1916	9.	1.7			Good but spikes loose.			7.10

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
						GUM	—(Red)—	(*Continued*).					
						ZINC	CHLORIDE	—(BURNETT).					
9.1				75				0.50	1909	C.B.&Q.	Lines East		
9.2				12					1911	"	" "		
9.3				43					1909	"	Lines West		
9.4	6x8x8	Sawed		40			0.7285	0.2738	1905	G.H.& S.A.	Bay View.		
9.5	6x8x8	"		45			0.7285	0.2738	1905	"	" "		
9.6	6x8x8	"		44			0.7285	0.2738	1905	"	" "		
9.7	6x8x8	"		32			0.8107	0.3047	1905	"	" "		
9.8	6x8x8	"		34			0.8107	0.3047	1905	"	" "		
9.9	6x8x8	"		49			0.8107	0.3047	1905	"	" "		
						ZINC	CREOSOTE	—(CARD).					
10.1				414				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
10.2				232				Zn. 0.50 Cre. 3.00	1909	"	Lines West		
10.3				194				Zn. 0.50 Cre. 3.00	1908	"	Lines East		
							ZINC-CREO	SOTE.					
11.1	6x8x8	"		12			Zn. 1.01 Cr. 17.7	Zn. 0.27 Cre. 4.49	1905	G.H.& S.A.	Bay View		
11.2	6x8x8	"		16			Zn. 1.01 Cr. 17.7	Zn. 0.27 Cre. 4.49	1905	"	" "		
11.3	6x8x8	"		17			Zn. 1.01 Cr. 17.7	Zn. 0.27 Cre. 4.49	1905	"	" "		
							GUM—(T	upelo).					
						CR	EOSOTE—(	FULL-CEL	L).				
12.1				97				10.99	1909	C.B.&Q.	Lines East		
12.2				54				10.99	1909	"	Lines West		
12.3	6x8x8	"		33			29.82	11.21	1905	G.H.& S.A.	Bay View		
12.4	6x8x8	"		36			29.82	11.21	1905	"	" "		

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Indx No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. In-spected	Time Service	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Refer-ence No.
					GUM—(Red)	—(*Continued*).									
					ZINC	CHLORIDE	—(	BURNETT	).						
9.1	Partly		Cut	75-85-90	Cin. Gr., Bt. Cl.		1916	7.	21.3						5.20
9.2	Yes		"	75	Gravel		1916	5.	0					No plates under joints.	5.20
9.3	"		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	18.6						5.20
9.4			Screw				1916	11.	87.5						7.10
9.5	Glendon						1916	11.	100.00				6.7	All out 11 years.	7.10
9.6	None						1916	11.	93.1						7.10
9.7			Screw				1916	11.	87.5						7.10
9.8	Glendon						1916	11.	97.8					Started to fail 1909.	7.10
9.9	None						1916	11.	91.8					" " " 1909.	7.10
					ZINC-CREOSOTE—(CARD).										
10.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	3.6						5.20
10.2	Yes		"	75-85-90	"		1916	7.	0.9						5.20
10.3	"		"	90	Gravel		1916	8.	24.2						5.20
						ZINC-CREOSOTE.									
11.1			Screw				1916	11.	41.6					Seasoned 1 year after treat.	7.10
11.2	Glendon						1916	11.	68.7					" " " " "	7.10
11.3	None						1916	11.	41.1					" " " " " Started to fail in 1910.	7.10
					GUM—(Tupelo).										
					CREOSOTE—(FULL-CELL).										
12.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	0						5.20
12.2	Yes		"	75-85-90	"		1916	7.	0						5.20
12.3			Screw				1916	11.	30.3					Seasoned 1 year after treat.	7.10
12.4	Glendon						1916	11.	36.0					" " " " "	7.10

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							GUM—(Tupelo)—(*Continued*).						
12.5	6x8x8	Sawed		44			29.82	11.21	1905	G.H.& S.A.	Bay View		
12.6	6x8x8	"		23			35.14	13.21	1905	"	" "		
12.7	6x8x8	"		30			35.14	13.21	1905	"	" "		
12.8	6x8x8	"		35			35.14	13.21	1905	"	" "		
							UNTREATED.						
13.1				88					1909	C.B.&Q.	Lines East		
13.2				48					1909	"	Lines West		
					ZINC	CHLORIDE—(BURNETT).							
14.1				76				0.50	1909	C.B.&Q.	Lines East		
14.2				41				0.50	1909	"	Lines West		
14.3	6x8x8	"		30			0.5955	0.2239	1905	G.H.& S.A.	Bay View		
14.4	6x8x8	"		37			0.5955	0.2239	1905	"	" "		
14.5	6x8x8	"		46			0.5955	0.2239	1905	"	" "		
14.6	6x8x8	"		33			0.6224	0.234	1905	"	" "		
14.7	6x8x8	"		30			0.6224	0.234	1905	"	" "		
						ZINC CREOSOTE—(CARD).							
15.1				435				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
15.2				237				Zn. 0.50	1909	"	Lines West		
15.3	6x8x8	Sawed		12			Zn. 0.5952 C. 5.38	Zn. .2239 Cre. 2.02	1905	G.H.& S.A.			
15.4	6x8x8	"		14			Zn. 0.5952 C. 5.38	Zn. 2239 Cre. 2.02	1905	"	Bay View		
15.5	6x8x8	"		16			Zn. 0.5952 C. 5.38	Zn. 2239 Cre. 2.02	1905	"	" "		
						HACKBERRY.							
					ZINC	CREOSOTE—(CARD).							
1.1				47				Zn. 0.50 Cre. 3.00	1911	C.B.&Q.	Utica, Neb.		

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Service Conditions—*(Continued)*.							Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					GUM—(Tupelo)—(*Continued*).										
12.5	None						1916	11.	40.9					Seasoned 1 year after treat.	7.10
12.6			Screw				1916	11.	26.1					" " " " "	7.10
12.7	Glendon						1916	11.	16.7					" " " " "	7.10
12.8	None						1916	11.	45.8					" " " " "	7.10
						UNTREATED.									
13.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	100.0				2.9		5.20
13.2	Yes		"	75-85-90	"		1915	6.	100.0				4.0		5.20
					ZINC CHLORIDE—(BURNETTIZED).										
14.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	6.6						5.20
14.2	Yes		"	75-85-90	"		1916	7.	2.4						5.20
14.3			Screw				1916	11.	93.2					Started to fail 1908.	7.10
14.4	Glendon						1916	11.	97.2					" " " 1910.	7.10
14.5	None						1916	11.	93.3					" " " 1910.	7.10
14.6	Glendon						1916	11.	90.9					" " " 1910.	7.10
14.7	None						1916	11.	89.9					" " " 1911.	7.10
					ZINC-CREOSOTE—(CARD).										
15.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	2.3						5.20
15.2	Yes		"	75-85-90	"		1916	7.	0.4						5.20
15.3			Screw				1916	11.	91.6					Started to fail 1910.	7.10
15.4	Glendon						1916	11.	71.4					" " " 1911.	7.10
15.5	None						1916	11.	100.0				8.5	" " " 1912.	7.10
						HACKBERRY.									
					ZINC-CREOSOTE—(CARD).										
1.1	None		Cut	85	Burnt Clay	Heavy	1916	5.0	0			Good			5.20

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
						HEM	LOCK—(	Eastern).					
						CR	EOSOTE—(	FULL-CEL	L).				
1.1				87				7.87	1909	C.B.&Q.	Lines East		
1.2				50				7.87	1910	"	" "		
1.3				17				7.87	1911	"	" "		
1.4				46				7.87	1909	"	Lines West		
1.5				52				7.87	1910	"	" "		
						CRE	OSOTE—(O	PEN-TAN	K).				
2.1	6x8x8	Hewed	Peeled and unpeeled—various seasons	33		19 to 33'		14.3	1907	C.&N.W.	Janesville, Wis.		
							UNTRE	ATED.					
3.1				85					1909	C.B.&Q.	Lines East		
3.2				25					1910	"	" "		
3.3				47					1909	"	Lines West		
3.4				30					1910	"	" "		
3.5	6x8x8	"	Soaked seasoned 29 mos.	20					1907	C.&N.W.	Janesville, Wis.		
3.6	6x8x8	"	Peeled seasoned 26 mos.	20		19 to 33'			1907	"	" "		
3.7	6x8x8	"	Peeled seasoned 35 mos.	20		19 to 33'			1907	"	" "		
3.8	6x8x8	"	Unpeeled-seasoned 11 mos.	50		19 to 33'			1907	"	" "		
						ZINC	CHLORIDE	—(BURNE	TT).				
4.1				70				0.50	1909	C.B.&Q.	Lines East		
4.2				56				0.50	1910	"	" "		
4.3				43				0.50	1909	"	Lines West		
4.4				45				0.50	1910	"	" "		
4.5	6x8x8	"	Peeled and seasoned 10 mos.	25		19 to 33'		0.26	1907	C.&N.W.	Janesville, Wis.		

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Index No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. In-spected	Time Service	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
						HEML	OC	K	—(E	aster	n).				
					CR	EOSOTE	—(	FUL	L-CE	LL).					
1.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	1.1						5.20
1.2	All		"	90	Gravel		1916	6.0	0						5.20
1.3	Yes		"	75	"		1916	5.0	0					No tie-plates under joints.	5.20
1.4	"		"	85-90	Cin., Gr., Bt. Cl.		1916	7.0	0							5.20
1.5	"		"	90	Lyons Stone		1916	6.0	0							5.20
					CRE	OSOTE	—(	OP	EN-T	ANK	).				
2.1	Wal-haupter		Cut	90	Gravel		1916	8.5	0			93.9% Good		6.1% partly decayed.	26.00
						UN	TR	EAT	ED.						
3.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	100.0				4.2		5.20
3.2	All		"	90	Gravel		1916	6.0	76.0						5.20
3.3	Yes		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	95.8						5.20
3.4	"		"	90	Lyons Stone		1916	6.0	80.0						5.20
3.5	None		"	90	Sand	Light	1916	8.5	100.0				6.5		26.00
3.6	"		"	90	"	"	1916	8.5	95.0			5% partly decayed			26.00
3.7	"		"	90	"	"	1916	8.5	100.0				6.3		26.00
3.8	"		"	90	"	"	1916	8.5	88.0					12% decayed and partly decayed.	26.00
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
4.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	2.8						5.20
4.2	All		"	90	Gravel		1916	6.0	1.8						5.20
4.3	Yes		"	85-90	Cin.,Gr., Bt. Cl.		1916	7.0	0						5.20
4.4	"		"	90	Lyons Stone		1916	6.0	0						5.20
4.5	Wal-haupter		"	90	Gravel		1916	8.5	16.0			80% Good		4% partly decayed.	26.00

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Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
						HEM	LOCK—(	Eastern)	—(*Co*	*ntinued*	).		
						ZINC-	CREOSOTE	—(CARD).					
5.1				511				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
5.2				298				Zn. 0.50 Cre. 3.00	1910	"	" "		
5.3				277				Zn. 0.50 Cre. 3.00	1909	"	Lines West		
5.4				210				Zn. 0.50 Cre. 3.00	1910	"	" "		
5.5	7x7x8	Pole Sawed Hewed	Seasoned 8 mos.	107	Wis.	17 to Rl.		Zn. 0.50 Cre. 2.00	1911	C.M.& St.P.	Bardwell, Wis.	3° Curve	0
5.6	8x10x8½	Hewed	Seasoned	1,000	Mich.	18 to Rl.		Zn. 0.50 Cre. 2.00	1910	"	Adeline, Ill.	3° Curve	
5.7	7x9x9		Seasoned 8 mos.	132	"	18 to Rl.		Zn. 0.50 Cre. 2.00	1908	"	Braymer, Mo.	2° Curve	
						ZINC-	TANNIN—(	WELLHO	USE).				
					(S	ee Tam	arack Index	Nos. 10.1-1	0.4).				
6.1	6x8x8	"		16,197				0.50	1900	C.R.I.&P.	Sibley, Ia.		
6.2				142				Z.C. 0.443 Gel. 0.072 Tan. 0.086	1905	C.&N.W.	Clyman, Wis.		
6.3				10,792				Z.C. 0.443 Gel. 0.072 Tan. 0.086	1905	"	West Elgin, Ill.		
6.4	6x8x8	"	Peeled and seasoned 17 mos.	55		19 to 33'		0.532	1907	"	Janesville, Wis.		
6.5	6x8x8	"	Peeled and seasoned 16.5 mos.	40		19 to 33'		0.564	1907	"	" "		
6.6	6x8x8	"	Peeled and seasoned 16 mos.	41		19 to 33'		0.408	1907	"	" "		
6.7	6x8x8	Hewed	Peeled and seasoned 15 mos.	40		19 to 33'		0.464	1907	C.&N.W.	Janesville, Wis.		
6.8	6x8x8	"	Peeled and seasoned 14 mos.	40		19 to 33'		0.428	1907	"	" "		
6.9	6x8x8	"	Peeled and seasoned 12 mos.	37		19 to 33'		0.376	1907	"	" "		

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Index No.	Service Conditions—(Continued). Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. In-spected	Time Service	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					HEMLOCK—	(Easter	n)	—(	*Conti*	*nue*	*d*).				
					ZINC-CREOSO	TE—(C	AR	D).							
5.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	3.9						5.20
5.2	All		"	90	Gravel		1916	6.0	0						5.20
5.3	Yes		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	1.1						5.20
5.4	"		"	90	Lyons Stone		1916	6.0	1.4						5.20
5.5	A. S. Malleable	4x8	"	75	Gravel	Heavy	1916	5.0	0			84.1% Good		Includes 8 tamarack. 11.2% badly rail-cut.	6.11
5.6	A. S. Malleable	5x8		100	"	"	1916	6.0	39.0					Removed acct. wreck. No sign of decay.	6.11
5.7	M. I. Sellers	4x8 5x8	"	85	Burnt Gumbo	"	1916	8.0	0			Good		Inside of curve plated in 1916. Somewhat rail-cut.	6.11
					ZINC-TANNIN	—(WEL	LH	OU	SE).						
					(See	Tamarack	Ind	ex N	os. 10.	1-10.	4).				
6.1	None		Cut	60	Dirt, Gr. & Cin.	Light	1916	16.0	39.2					Solution 3.6-4%.	36.00
6.2							1914	9.0	30.3			41.5% good		24.6% of ties are fair.	48.00
6.3			"	72	Gravel		1916	11.0	86.8						48.00
6.4	Sellers		Screw	90	"	Light	1916	8.5	10.9			85.5% good		3.6% decayed.	26.00
6.5	"		"	90	"	"	1916	8.5	0			95% good		5% partly decayed.	26.00
6.6	"		"	90	"	"	1916	8.5	0			92.7% good		7.3% " "	26.00
6.7	Sellers		Screw	90	Gravel	Light	1916	8.5	0			95% Good		2.5% partly split. 2.5% partly decayed.	26.00
6.8	"		"	90	"	"	1916	8.5	0			97.5% Good		2.5% decayed.	26.00
6.9	"		"	90	"	"	1916	8.5	2.7			89.2% Good		8.1% partly decayed, decayed and partly split.	26.00

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
						HEM	LOCK—(	Eastern)	—(*Co*	*ntinued*	).		
6.10	6x8x8	Hewed	Peeled and seasoned 11 mos.	41		19 to 33′		0.340	1907	C.&N.W.	Janesville, Wis.		
6.11	6x8x8	"	Peeled and seasoned 11 mos.	40		19 to 33′		0.384	1907	"	" "		
6.12	6x8x8	"	Unpeeled and seasoned 17 m.	24		19 to 33′		0.728	1907	"	" "		
6.13	6x8x8	"	Unpeeled and seasoned 16 m.	25		19 to 33′		0.60	1907	"	" "		
6.14	6x8x8	"	Unpeeled and seasoned 12 m.	40		19 to 33′		0.592	1907	"	" "		
6.15	6x8x8	"	Soaked and seasoned 17 m.	47		19 to 33′		0.516	1907	"	" "		
6.16	6x8x8	"	Soaked and seasoned 17 m.	40		19 to 33′		0.468	1907	"	" "		
6.17	6x8x8	"	Peeled and seasoned 16.5 mos.	40		19 to 33′		0.564	1907	"	" "		
6.18	6x8x8	"	Peeled and seasoned 16 mos.	40		19 to 33′		0.428	1907	"	" "		
6.19	6x8x8	"	Peeled and seasoned 10 mos.	40		19 to 33′		0.512	1907	"	" "		
6.20	6x8x8	"	Peeled and seasoned 14 mos.	40		19 to 33′		0.428	1907	"	" "		
6.21	6x8x8	"	Peeled and seasoned 12 mos.	40		19 to 33′		0.452	1907	"	" "		
6.22	6x8x8	"	Peeled and seasoned 11 mos.	40		19 to 33′		0.352	1907	"	" "		
6.23	6x8x8	"	Peeled and seasoned 11 mos.	39		19 to 33′		0.448	1907	"	" "		
6.24	6x8x8	"	Unpeeled and seasoned 17 m.	25		19 to 33′		0.728	1907	"	" "		
6.25	6x8x8	"	Unpeeled and seasoned 14 m.	25		19 to 33′		0.584	1907	"	" "		
6.26	6x8x8	"	Unpeeled and seasoned 10 m.	40		19 to 33′		0.512	1907	"	" "		
6.27	6x8x8	"	Soaked and seasoned 16 m.	44		19 to 33′		0.476	1907	"	" "		

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Indx No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. In-spected	Time Ser-vice	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Refer-ence No.
					HEMLOCK—	(Easter	n)	—(	*Conti*	*nue*	*d*).				
6.10	Sellers		Screw	90	Gravel	Light	1916	8.5	9.8			75.6% Good		12.2% decayed and partly decayed. 2.4% partly split.	26.00
6.11	"		"	90	"	"	1916	8.5	0			90% Good		7.5% partly decayed; 2.5% partly split.	26.00
6.12	"		"	90	"	"	1916	8.5	0			95.8% Good		4.2% partly decayed.	26.00
6.13	"		"	90	"	"	1916	8.5	0			88% Good		4% partly decayed; 8% partly split.	26.00
6.14	"		"	90	"	"	1916	8.5	2.5			90% Good		5% decayed and partly decayed; 2.5% partly split.	26.00
6.15	"		"	90	"	"	1916	8.5	2.1			89.3% Good		8.5% decayed and partly decayed.	26.00
6.16	"		"	90	"	"	1916	8.5	2.5			90% Good		5% partly decayed; 2.5% partly split.	26.00
6.17	"		"	90	"	"	1916	8.5	5.0			87.5% Good		7.5% partly decayed.	26.00
6.18	"		"	90	"	"	1916	8.5	0			95% Good		5% partly decayed.	26.00
6.19	"		Cut	90	"	"	1916	8.5	0			97.5% Good		2.5% decayed.	26.00
6.20	"		"	90	"	"	1916	8.5	0			97.5% Good		2.5% partly decayed.	26.00
6.21	"		"	90	"	"	1916	8.5	2.5			95% Good		2.5% partly decayed.	26.00
6.22	"		"	90	"	"	1916	8.5	5.0			82.5% Good		5% partly decayed; 7½% partly split.	26.00
6.23	"		"	90	"	"	1916	8.5	0			100% Good			26.00
6.24	"		"	90	"	"	1916	8.5	0			100% Good			26.00
6.25	"		"	90	"	"	1916	8.5	0			100% Good			26.00
6.26	"		"	90	"	"	1916	8.5	0			97.5% Good		2.5% partly decayed.	26.00
6.27	"		"	90	"	"	1916	8.5	2.3			93.2% Good		4.6% decayed.	26.00

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
						HEM	LOCK—(	Eastern)	—(*Co*	*ntinued*	).		
6.28	6x8x8	Hewed	Peeled and seasoned 17 mos.	39		19 to 33′		0.516	1907	C.&N.W.	Janesville, Wis.		
6.29	6x8x8	"	Peeled and seasoned 16 mos.	41		19 to 33′		0.556	1907	"	" "		
6.30	6x8x8	"	Peeled and seasoned 15 mos.	43		19 to 33′		0.452	1907	"	" "		
6.31	6x8x8	"	Peeled and seasoned 14 mos.	39		19 to 33′		0.448	1907	"	" "		
6.32	6x8x8	"	Peeled and seasoned 13 mos.	40		19 to 33′		0.388	1907	"	" "		
6.33	6x8x8	"	Peeled and seasoned 12 mos.	40		19 to 33′		0.376	1907	"	" "		
6.34	6x8x8	"	Peeled and seaseasoned 11 mos.	40		19 to 33′		0.428	1907	"	" "		
6.35	6x8x8	"	Peeled and seasoned 10 mos.	40		19 to 33′		0.388	1907	"	" "		
6.36	6x8x8	"	Unpeeled and seasoned 16 m.	25		19 to 33′		0.564	1907	"	" "		
6.37	6x8x8	"	Unpeeled and seasoned 13 m.	21		19 to 33′		0.484	1907	"	" "		
6.38	6x8x8	"	Unpeeled and seasoned 10 m.	40		19 to 33′		0.544	1907	"	" "		
6.39	6x8x8	"	Unpeeled, soaked, seasoned 15 mos.	49		19 to 33′		0.500	1907	"	" "		
6.40	6x8x8	"	Peeled and unpeeled seasoned 10 m.	53		19 to 33′		0.356	1907	"	" "		
6.41	6x8x8	"	Peeled and unpeeled seasoned 18 m.	51		19 to 33′		0.356	1907	"	" "		
6.42	6x8x8	"	Peeled, unpeeled, seasoned 10 mos.	51		19 to 33′		0.436	1907	"	" "		

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					HEMLOCK—	(Easter	n)	—(	*Conti*	*nue*	*d).*				
6.28	Wal-haupter		Cut	90	Gravel	Light	1916	8.5	0			87.2% Good		10.2% decayed and partly decayed; 2.6% partly split.	26.00
6.29	"		"	90	"	"	1916	8.5	0			97.6% Good		2.4% decayed.	26.00
6.30	"		"	90	"	"	1916	8.5	0			100% Good			26.00
6.31	"		"	90	"	"	1916	8.5	0			97.4% Good		2.6% partly decayed.	26.00
6.32	"		"	90	"	"	1916	8.5	0			95% Good		5% partly decayed.	26.00
6.33	"		"	90	"	"	1916	8.5	2.5			87.5% Good		10% partly decayed.	26.00
6.34	"		"	90	"	"	1916	8.5	2.5			95% Good		2.5% partly decayed.	26.00
6.35	"		"	90	"	"	1916	8.5	0			85% Good		15% decayed and partly decayed.	26.00
6.36	"		"	90	"	"	1916	8.5	0			72% Good		28% partly decayed.	26.00
6.37	"		"	90	"	"	1916	8.5	0			90.5% Good		9.5% partly decayed.	26.00
6.38	"		"	90	"	"	1916	8.5	0			97.5% Good		2.5% decayed.	26.00
6.39	"		"	90	"	"	1916	8.5	0			93.9% Good		6.1% partly decayed.	26.00
6.40	"		"	90	"	"	1916	8.5	7.5			81.2% Good		11.3% decayed and partly decayed.	26.00
6.41	"		"	90	"	"	1916	8.5	5.8			80.4% Good		11.8% decayed and partly decayed; 2% partly split.	26.00
6.42	"		"	90	"	"	1916	8.5	4.0			80.4% Good		15.6% decayed and partly decayed.	26.00

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
						HEM	LOCK—(	Western).					
							UNTRE	ATED.					
1.1	7x9x8	Hewed	Green	100	Wash.				1906	N.P.	Maywood, Wash.	Tang.	.96
1.2	7x9x8	"	"	103	"				1906	"	" "	Tang.	.46
							HICKORY	—(Pignut	).				
						CR	EOSOTE—(	FULL-CEL	L).				
1.1				4					1910	C.B.&Q.	Blanding, Ill.		
1.2				14					1910	"	Barr, Colo.		
1.3				6					1910	"	Hanover, Ill.		
							UNTRE	ATED.					
2.1				65					1909	C.B.&Q.	Lines East		
2.2				30					1909	"	Lines West		
2.3				9					1910	"	Lines East		
2.4				15					1910	"	Lines West		
						ZINC	CHLORIDE	—(BURNE	TT).				
3.1				4				0.50	1910	C.B.&Q.	Blanding, Ill.		
3.2				15				0.50	1910	"	Barr, Colo.		
3.3				5				0.50	1910	"	Hanover, Ill.		
						ZINC-	CREOSOTE	—(CARD).					
4.1				164				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
4.2				89				Zn. 0.50 Cre. 3.00	1909	"	Lines West		
4.3				20				Zn. 0.50 Cre. 3.00	1910	"	Lines East		
4.4				16				Zn. 0.50 Cre. 3.00	1910	"	Lines West		

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					SERVICE CONDITIONS—*(Continued)*.				RESULTS.						
					HEMLOCK—	(Weste	rn	).							
						UN	TR	EAT	ED.						
1.1	Sellers		Cut	85	Gravel	Heavy	1915	8.5	100.0				7.3		25.00
1.2	None		"	85	"	"	1915	8.5	100.0				7.3		25.00
					HICKORY—	(Pignut	).								
					CR	EOSOTE	—(	FUL	L-CE	LL).					
1.1	All		Cut	90	Sheridan Gravel		1916	6.0	0						5.20
1.2	"		"	90	Lyons Stone		1916	6.0	0					Seasoned 1 year after treatment.	5.20
1.3	"		"	90	Sheridan Gravel		1916	6.0	0						5.20
						UN	TR	EAT	ED.						
2.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	69.2						5.20
2.2	All		"	75-85-90	"		1916	7.0	90.0						5.20
2.3	"		"	90	Gravel		1916	6.0	77.8						5.20
2.4	"		"	90	Lyons Stone		1916	6.0	60.0						5.20
					ZINC-CREOSO	TE—(C	AR	D).							
3.1	All		Cut	90	Gravel		1916	6.0	0						5.20
3.2	"		"	90	Lyons Stone		1916	6.0	0					Seasoned 1 year after treatment.	5.20
3.3	"		"	90	Gravel		1916	6.0	0						5.20
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
4.1	Partly		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	4.3						5.20
4.2	All		"	85-90	"		1916	7.0	6.7						5.20
4.3	"		"	90	Gravel		1916	6.0	0						5.20
4.4	"		"	90	Lyons Stone		1916	6.0	0						5.20

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Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
							JUNIPER.						
						CR	EOSOTE—(	FULL-CEL	L).				
1.1		Hewed	Seasoned 10 mos.	25				8	1897	N.S.	Norfolk, Va. Div.	2° Curve	
1.2			Seasoned 10 mos.	75				8	1897	"	" " "	Tang.	
							UNTRE	ATED.					
2.1		"	Seasoned 14 mos.	100					1897	"	Norfolk, Va. Div.	Tang.	
2.2		"	Seasoned 14 mos.	100					1897	N.S.	" " "	"	
2.3		"	Seasoned 14 mos.	100					1897	"	" " "	"	
2.4		"	Seasoned 14 mos.	100					1897	"	" " "	"	
2.5		"	Seasoned 14 mos.	100					1897	"	" " "	"	
2.6		"	Seasoned 14 mos.	120					1897	"	" " "	"	
2.7		"	Seasoned 14 mos.	100					1897	"	" " "	"	
2.8		"	Seasoned 14 mos.	200					1897	"	" " "	"	
							LAR	CH—(Wes	tern)				
					CRE	OSOTE	—STEAMIN	G—(BETH	ELL).				
1.1	7x8x8	18% Hewed 82% Sawed	Seasoned 14 mos.	50	Mont. & Ida.	19 to Rl.	28.2	9.05	1915	N.P.	Thompson Falls, Mont.	2° Curve	0.300

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Service Conditions—*(Continued)*.						Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Refer-erence No.
					JUNIPER—(*Continued*).										
					CREOSOTE—(STEAM).										
1.1	Yes		Cut	70	Gravel		1916	19.0	52.0					Started to fail in 1909. Piled 5 mos. after treatment; 50% tie-plated.	16.10
1.2	"		"	70	"		1916	19.0	11.0					Piled 5 mos. after treatment; 50% tie-plated. Started to fail in 1911.	16.10
					UNTREATED.										
2.1	Felt		Cut	70	Gravel		1916	19.0	87.0					Started to fail 1908.	16.10
2.2			Lags & Clips	70	"		1916	19.0	78.0					" " " 1908. Ties covered—ballast.	16.10 16.10
2.3			Cut	70	"		1916	19.0	77.0					⅛ of tie in ballast—sloped to ends. Started to fail 1907.	16.10
2.4	Goldie		"	70	"		1916	19.0	75.0					Started to fail 1905. Ballast top of tie at center.	16.10
2.5			"	70	"		1916	19.0	73.0					Started to fail 1907. Ballast 2" wide at center of slope.	16.10
2.6			"	70	"		1916	19.0	79.0						
2.7			"	70	"		1916	19.0	63.0					Started to fail 1905.	16.10
2.8			"	70	"		1916	19.0	82.5					Started to fail 1901.	16.10
					LARCH—(Western).										
					CREOSOTE—STEAM.										
1.1	N.P.Std.	7x9	Cut	90	Gravel and Sand	8,270,506	1916	1.0	0			Good			25.00

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
						LAR	CH—(Wes	tern)—(C	*ontin*	*ued*).			
1.2	7x8x8	98% Hewed 2% Sawed	Seasoned 14 mos.	101	Mont. & Ida.	19 to Rl.	28.2	9.05	1915	N.P.	Thompson Falls, Mont.	2° Curve	0.300
1.3	7x8x8	47% Hewed 53% Sawed	Seasoned 14 mos.	150	Mont. & Ida.	19 to Rl.	28.2	9.05	1915	"	Thompson Falls, Mont.	1° Curve	0.360
1.4	7x8x8	99% Hewed 1% Sawed	Seasoned 14 mos.	71	Mont. & Ida.	19 to Rl.	28.2	9.05	1915	"	Thompson Falls, Mont.	1° Curve	0.360
							UNTRE	ATED.					
						(See Ta	marack Index	Nos. 6.5-6.9	).				
2.1	7x9x8	Hewed	Seasoned	90	Mts.	18 to Rl.			1907	N.P.	Plains, Mont.	Tang.	0.0170
2.2	7x9x8	"	"	90	"	18 to Rl.			1907	"	" "	"	0.0170
2.3	7x9x8	"	Unseasoned	92	"	18 to Rl.			1907	"	" "	"	0.0170
2.4	7x8x8	10% Hewed 90% Sawed	Seasoned 14 mos.	50	Mont. & Ida.	19 to Rl.			1915	"	Thompson Falls, Mont.	2° Curve	0.300
2.5		Triang.		1,469					1911	G.N.	Butte, Div.	70% Tang. 30% Curve	
2.6		Sawed		1,277					1911	"	" "	70% Tang. 30% Curve	
2.7		Square Slabbed		1,236					1911	"	" "	70% Tang. 30% Curve	
						ZINC	CHLORIDE	—(BURNE	TT).				
						(See Ta	marack Index	Nos. 7.6-7.8	).				
3.1	7x9x8	Hewed	Seasoned	101	Mts.	18 to Rl.		0.874	1907	N.P.	Plains, Mont.	Tang.	0.0170

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Service Conditions—*(Continued)*.						Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Refer-ence No.
					LARCH—(W	estern)	—(	*Co*	*ntinu*	*ed*).					
1.2	Vignoles bolted to	Rail Ch	airs	90	Gravel and Sand	8,270,506	1916	1.0	0			Good			25.00
1.3	N.P.Std.	7x9	Cut	90	"	8.270,506	1916	1.0	0			"			25.00
1.4	Vignoles bolted to	Rail Ch	airs	90	"	8.270,506	1916	1.0	0			"			25.00
						UN	TR	EAT	ED.						
					(See	Tamarack	Ind	ex	Nos.	6.5-	6.9).				
2.1	Sellers		S. & C.	85	Gravel	8,270,506	1916	9.3	100.0				7.4		25.00
2.2	"		Screw	85	"	8,270,506	1916	9.3	100.0				7.4		25.00
2.3	"		"	85	"	8,270,506	1916	9.3	100.0				7.3		25.00
2.4	N.P.Std.	7x9	Cut	90	Gravel and Sand	8,270,506	1916	1.0	0			Good			25.00
2.5	Goldie	6x8½	⅝x6	90	Gravel 10 in.		1916	5.3	4.0					Removed acct. decay and split.	40.10
	J. G. 58	6½x8½										Fair		About 35% to come out in 1917.	40.10
	J. G. 58	6½x8½			"		1916	5.3	4.0	4.0		Poor		Large renewals in 1917.	40.10
2.6	Goldie	6x8½	⅝x6	90	"										
	J. G. 58	6½x8½			"		1916	5.3	1.0	1.0		59.4% Good		1% split, 4% partly split, 35.6% turned over.	25.00
2.7	Goldie	6x8½	⅝x6	90											
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
					(See	Tamarack	Ind	ex	Nos.	7.6-	7.8).				
3.1	Sellers		Screw	85	Gravel	8,270,506	1916	9.3	1.0			59.4% Good		1% split, 4% partly split. 35.6% turned over.	25.00

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
					LA	RCH	—(WEST	ERN)—*C*	*ontin*	*ued*).			
3.2	7x9x8	Hewed	Seasoned	92	Mts.	18 to Rl.		0.874	1907	N.P.	Plains, Mont	Tang.	0.0170
3.3		Sawed Triang.		1,228				0.500	1911	G.N.	Butte Div.	Tang. 70% Curve 30%	
3.4		Slabbed		1,273				0.500	1911	"	Butte, Mont.	Tang. 70% Curve 30%	
3.5		Sawed Square		1,318				0.500	1911	"	" "	Tang. 70% Curve 30%	
3.6		Sawed Triang.		2,053				0.750	1911	"	" "	Tang. 70% Curve 30%	
3.7		Slabbed		1,433				0.750	1911	"	" "	Tang. 70% Curve 30%	
							MAPLE.						
						CR	EOSOTE—(	FULL-CEL	L).				
						(See	Beech Index	No. 1.6).					
1.1	6x8x8		Seasoned 6-18 mos.	50	N. E. Wis.	18 to Rl.		12.0	1911	C.M.& St.P.	Hartford, Wis.	Tang. level	0
1.2	6x8x8		Seasoned 6-18 mos.	50	N. E. Wis.	18 to Rl.		12.0	1911	"	" "	" "	0
						CR	EOSOTE—(	LOWRY.)					
					(See	Beech,	Index No.	2.1, and Oa	k 16.3	-16.28).			
						CR	EOSOTE—(	RUEPING	).				
						(See	Beech Index	Nos. 3.2-3.3	).				
2.1	6x8x8		Seasoned 6-18 mos.	50	N. E. Wis.	18 to Rl.		4.9	1911	C.M.& St.P.	Hartford, Wis.	Tang. level	0
2.2	6x8x8		Seasoned 6-18 mos.	50	N. E. Wis.	18 to Rl.		4.9	1911	"	" "	" "	0

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Service Conditions—*(Continued)*.							Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					LARCH—(W	estern)'	—(	*Co*	*ntinue*	*ed*).					
3.2	Sellers		S. & C.	85	Gravel	8,270,506	1916	9.3	10.9			60.8% Good		Removed acct. split. 3.3% partly split, 25% turned over.	25.00
3.3	Goldie G. 58 J. G. 58	6x8½ 6½x8½	⅝x6	90	Gravel 10 in.		1916	5.3	0			Good		4% Zinc Chloride Solution.	40.10
3.4	Goldie	6x8½ 6½x8½	⅝x6	90	Gravel 10 in.		1916	5.3	0			"		4% Zinc Chloride Solution.	40.10
3.5	"	6x8½ 6½x8½	⅝x6	90	"		1916	5.3	1.0	1.0		"		4% Zinc Chloride Solution.	40.10
3.6	"	6x8½ 6½x8½	⅝x6	90	Gravel 10 in.		1916	5.3	0			"		6% Zinc Solution.	40.10
3.7	"	6x8½ 6½x8½	⅝x6	90	Gravel 10 in.		1916	5.3	0			"		6% Zinc Solution.	40.10
					MAPLE.										
					CR	EOSOTE	—(	FUL	L-CE	LL).					
						(See Bee	ch	Inde	x No.	1.6).					
1.1	Economy	7½x9	Screw	90	Gravel	Heavy	1916	5.0	0			96% Good		4% partly split and partly decayed.	27.00
1.2	None		Cut	90	"	"	1916	5.0	0			96% Good		4% partly split and partly decayed.	27.00
						CREOSO	TE	—(	LOW	RY).					
					(See Beech,	Index N	o.	2.1	and	Oak,	16.3-	16.28).			
						CREOSO	TE	—(R	UEP	ING).					
					(See Beech Index	Nos. 3.2-	3.3	).							
2.1	Economy	7½x9	Screw	90	Gravel	Heavy	1916	5.0	0			99% Good		1% partly split.	27.00
2.2	None		Cut	90	"	"	1916	5.0	0			99% Good		1% " "	

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							MAPLE—(	*Continued*	).				
				OIL	SEMI-	REFIN	ED—PARAF	FIN BASE	—(FU	EL-CEL	L).		
3.1	6x8x8		Seasoned 6-18 mos.	50	N. E. Wis.	18 to Rl.		12.6	1911	C.M.& St.P.	Hartford, Wis.	Tang. level	0
3.2	6x8x8		Seasoned	50	N. E. Wis.	18 to Rl.		12.6	1911	"	" "	" "	0
							UNTRE	ATED.					
4.1	6x8x8		"	50	N. E. Wis.	18 to Rl.			1911	C.M.& St.P.	Hartford, Wis.	Tang. level	0
4.2	6x8x8		Seasoned 6-18 mos.	50	N. E. Wis.	18 to Rl.			1911	"	" "	" "	0
						ZINC	CHLORIDE	—(BURNE	TT).				
						(See	Beech Index	Nos. 9.8-9.11	).				
5.1	6x8x8		Seasoned 6-18 mos.	50	N. E. Wis.	18 to Rl.		0.50	1911	C.M.& St.P.	Hartford, Wis.	Tang. level	0
5.2	6x8x8		Seasoned 6-18 mos.	50	N. E. Wis.	18 to Rl.		0.50	1911	"	" "	" "	0
						ZINC-	CREOSOTE	—(CARD).					
6.1	7x9x9		Seasoned 6-18 mos.	50	N. E. Wis.	18 to Rl.	10	Zn. 0.37 Cre. 3.10	1911	C.M.& St.P.	Hartford, Wis.	Tang. level	0
6.2	7x9x9		Seasoned 6-18 mos.	225		18 to Rl.		Zn. 0.37 Cre. 3.10	1911	"	" "	" "	0
6.3	6x8x8			325		18 to Rl.		Zn. 0.50 Cre. 2.00	1908	C.&N.W.	St. Francis, Wis.	" "	0
6.4	6x8x8			125				Zn. 0.50 Cre. 2.00	1908	"	" "		
6.5	6x8x8							Zn. 0.50 Cre. 2.00	1908	"	" "		

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Indx No.	Service Conditions—*(Continued)*. Tie Plates Kind	Tie Plates Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. In-spected	Time Service	Removed %	Cause R'm'v'l Decay %	Cause R'm'v'l Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					MAPLE—(	*Continued*	).								
				OIL	SEMI-REFINED	—PARA	FFI	N	BASE	—(F	ULL	-CELL).			
3.1	Economy	7½x9	Screw	90	Gravel	Heavy	1916	5.0	0			98% Good		2% partly split.	27.00
3.2	None		Cut	90	"	"	1916	5.0	0			98% Good		2% " "	27.00
						UN	TR	EAT	ED.						
4.1	Economy	7½x9	Screw	90	Gravel	Heavy	1916	5.0	36.0	36.0		9% Good		54% partly decayed; 1% partly split.	27.00
4.2	None		Cut	90	"	"	1916	5.0	36.0	36.0		9% Good		54% partly decayed; 1% partly split.	27.00
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
						(See Beec	h,	Inde	x Nos.	9.8	9.11	).			
5.1	None		Cut	90	Gravel	Heavy	1916	5.0	0			99% Good		1% partly split.	27.00
5.2	Economy	7½x9	Screw	90	"	"	1916	5.0	0			99% Good		1% " "	27.00
					ZINC-CREOSO	TE—(C	AR	D).							
6.1	Economy	7½x9	Screw	90	Gravel	Heavy	1916	5.0	0			99% Good		20% Creosote; 80% Zinc Chloride; 1% partly split.	27.00
6.2	None		Cut	90	"	"	1916	5.0	0			99% Good		20% Creosote; 80% Zinc Chloride; 1% partly split.	27.00
6.3			"	90	Slag		1916	8.0	1.3					Mechanical wear ⅛ to ⅓.	48.00
6.4			"	90	"		1916	8.0	0						48.00
6.5			"	90	"		1916	8.0	0						48.00

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Cross-Tie Records—Service Tests—*(Continued)*.

DESCRIPTION OF MATERIAL.									SERVICE CONDITIONS				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							MAPLE—(	*Continued*	).				
						ZINC-	CREOSOTE	—TWO MO	VEME	NT).			
7.1	6x8x8		Seasoned 6-18 mos.	50	N. E. Wis.	18 to Rl.		Emulsion 15.5	1911	C.M.& St.P.	Hartford, Wis.	Tang. level	0
7.2	6x8x8		Seasoned 6-18 mos.	50	N. E. Wis.	18 to Rl.		Emulsion 15.5	1911	"	" "	" "	0
							MAPLE—(	Hard).					
						CR	EOSOTE—(	FULL-CEL	L).				
8.1				30				5.92	1909	C.B.&Q.	Lines East		
8.2				18				5.92	1909	"	Lines West		
8.3				50				5.92	1909	"	Lines East		
8.4				15				5.92	1910	"	Lines West		
8.5				15				5.92	1911	"	Lines East		
							UNTRE	ATED.					
9.1				52					1909	C.B.&Q.	Lines East		
9.2				30					1909	"	Lines West		
9.3				24					1910	"	Lines East		
9.4				15					1910	"	Lines West		
						ZINC	CHLORIDE	—(BURNE	TT).				
10.1				30				0.50	1910	C.B.&Q.	Hanover, Ill.		
10.2				20				0.50	1910	"	Blanding, Ill.		
10.3			Seasoned yr. after treatment	15				0.50	1910	"	Barr, Colo.		

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Index No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					MAPLE—(	Continued	).								
					ZINC-	CREOSOTE—(	TWO	MO	VE	MEN	T).				
7.1	Economy	7½x9	Screw	90	Gravel	Heavy	1916	5.0	0			99% Good		1% partly split. Special treatment. 3% Zn. Ch. + Creosote.	27.00
7.2	None		Cut	90	"	"	1916	5.0	0			99% Good		1% partly split. Special treatment. 3% Zn. Ch. + Creosote.	27.00
					MAPLE—	(Hard	).								
						CR	EOSOTE	—(	FUL	L-CE	LL).				
8.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	0						5.20
8.2	Yes		"	85-90	"		1916	7.0	0						5.20
8.3	All		"	90	Gravel		1916	6.0	0						5.20
8.4	Yes		"	90	Lyons Stone		1916	6.0	0						5.20
8.5	Except under joints		"	75	Gravel		1916	5.0	0						5.20
						UN	TR	EAT	ED.						
9.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1915	6.0	100.0				3.8		5.20
9.2	Yes		"	85-90	"		1916	7.0	100.0				4.7		5.20
9.3	All		"	90	Gravel		1916	6.0	87.5						5.20
9.4	Yes		"	90	Lyons Stone		1916	6.0	53.3						5.20
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
10.1	All		Cut	90	Sheridan Gravel		1916	6.0	0						5.20
10.2	"		"	90	"		1916	6.0	0						5.20
10.3	Yes		"	90	Lyons Stone		1916	6.0	0						5.20

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
							MAPLE—(	Hard)—(	*Conti*	*nued*).			
						ZINC	CREOSOTE	—(CARD).					
11.1				386				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
11.2				207				Zn. 0.50 Cre. 3.00	1909	"	Lines West		
11.3				175				Zn. 0.50 Cre. 3.00	1910	"	Lines East		
11.4				65				Zn. 0.50 Cre. 3.00	1910	"	Lines West		
11.5				550				Zn. 0.50 Cre. 3.00	1911	"	Utica, Neb.		
11.6	7x9x9		Seasoned 8 mos.	464	N. Mich.	18 to Rl.	10	Zn. 0.50 Cre. 2.00	1908	C.M.& St.P.	Braymer, Mo.	2°	
							MAPLE—(	Soft).					
						CR	EOSOTE—(	FULL-CEL	L).				
12.1				88				17.80	1909	C.B.&Q.	Lines East		
12.2				48				17.80	1910	"	Lines West		
12.3				50				17.80	1910	"	Lines East		
12.4				15				17.80	1909	"	Lines West		
							CRUDE	OIL.					
13.1				4					1911	C.B.&Q.	Baders, Ill.		
							UNTRE	ATED.					
14.1				57					1909	C.B.&Q.	Lines East		
14.2				29					1909	"	Lines West		
14.3				25					1910	"	Lines East		
14.4				14					1910	"	Lines West		

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					MAPLE—	(Hard	)	—(	*Conti*	*nued*	).				
•					ZI	NC CRE	OS	OT	E—(C	ARD	).				
11.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	3.1						5.20
11.2	Yes		"	85-90	"		1916	7.0	0.5						5.20
11.3	All		"	90	Gravel		1916	6.0	1.1						5.20
11.4	Yes		"	90	Lyons Stone		1916	6.0	0						5.20
11.5	"		"	85	Burnt Clay		1916	5.0	0			Good			5.20
11.6	None*		"	85	Burnt Gumbo	Heavy	1916	8.0	0			"		1 cross-checked; balance good. *In 1916 inside of curve plated with mx plates. Mal. Iron and Sellers 4x8 and 5x8.	6.11
					MAPLE—(	Soft).									
					CR	EOSOTE	—(	FUL	L-CE	LL).					
12.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.	3.4						5.20
12.2	All		"	85-90	"		1916	7.	0						5.20
12.3	"		"	90	Gravel		1916	6.	2.0						5.20
12.4	"		"	90	Lyons Stone		1916	6.	0						5.20
						CR	U	DE	OIL.						
13.1	Yes, except under joints		Cut	75	Gravel		1916	5.0	50.0						5.20
						UN	TR	EAT	ED.						
14.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	96.6				4.1		5.20
14.2	All		"	75-85-90	"		1915	6.0	100.0						5.20
14.3	"		"	90	Gravel		1916	6.0	96.0				3.9		5.20
14.4	"		"	90	Lyons Stone		1915	5.0	100.0						5.20

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							MAPLE—(	Soft)—(C	*ontin*	*ued*).			
						ZINC	CHLORIDE	—(BURNE	TT).				
15.1				75				0.50	1909	C.B.&Q.	Lines East		
15.2				41				0.50	1909	"	Lines East		
15.3				50				0.50	1910	"	Lines West		
15.4				15				0.50	1910	"	Lines East		
						ZINC	CREOSOTE	—(CARD).					
16.1				383				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
16.2				202				Zn. 0.50 Cre. 3.00	1909	"	" West		
16.3				75				Zn. 0.50 Cre. 3.00	1910	"	" East		
16.4				61				Zn. 0.50 Cre. 3.00	1910	"	Lines West		
16.5	6x8x8			112				Zn. 0.50 Cre. 2.00	1908	C.&N.W.	St. Francis, Wis.		
							OAK.						
						CR	EOSOTE—(	LOWRY.)					
1.1			Seasoned	845			Gal. 3.9		1914	D.L.&W.	Alford, Pa.		
1.2				6			Gal. 3.9		1912	"	Paterson, N. J.		
							OAK—(Bl	ack).					
						ZINC	CHLORIDE	—(BURNE	TT).				
2.1				106,122				0.33	1906	C.&E.I.	Villa Grove, Ill.		
2.2				79,963				0.33	1907	"	" "		
2.3				17,547				0.33	1908	"	" "		
2.4				869				0.33	1909	"	" "		
2.5				5,085				0.33	1910	"	" "		

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Service Conditions—*(Continued)*.						Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					MAPLE—(Soft)—	(C	ont	inued	).						
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
15.1	Partly		Cut	75-85-90	Cin., Gr., Stone		1916	7.0	6.7						5.20
15.2	All		"	85-90	Cin., Gr., Bt. Cl.		1916	7.0	9.8						5.20
15.3	"		"	90	Gravel		1916	6.0	0						5.20
15.4	"		"	90	Lyons Stone		1916	6.0	0						5.20
					ZINC-CREOSO	TE—(C	AR	D).							
16.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	6.8						5.20
16.2	All		"	85-90	"		1916	7.0	1.0						5.20
16.3	"		"	90	Gravel		1916	6.0	0						5.20
16.4	Partly		"	90	Lyons Stone		1916	6.0	0						5.20
16.5	None		"	90	Slag		1916	8.0	0					Mechanical wear ⅛ to ½.	48.00
					OAK.										
						CREOSO	TE	—(	LOW	RY).					
1.1	D.L.&W.		Screw	105	Stone		1916	2.0	0						44.10
1.2	"		"	101	"		1915	3.0	0						44.10
					OAK—(Black |).									
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
2.1							1915	9.0	9.7						8.10
2.2							1915	8.0	4.7						8.10
2.3							1915	7.0	2.7						8.10
2.4							1915	6.0	37.9						8.10
2.5							1915	5.0	0						8.10

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							OAK—(Black)—(*Continued*).						
					ZINC-	TANNIN—(WELLHOUSE).							
3.1				149,883				Zn. 0.50	1899-1900	C.&E.I.	Villa Grove, Ill.		
3.2				26,659				Zn. 0.50	1901	"	" " "		
3.3				16,925				Zn. 0.50	1902	"	" " "		
3.4				20,326				Zn. 0.50	1903	"	" " "		
3.5				27,105				Zn. 0.50	1904	"	" " "		
3.6				55,000				Zn. 0.50	1905	"	" " "		
							OAK—(Chestnut).						
							UNTREATED.						
4.1			Seasoned 4 mos.	424					1914	B.&O.	Medora, Ind.		
							OAK—(Mixed).						
					ZINC-	TANNIN—(		WELLHO	USE).				
5.1	6x8x8	Hewed		3,000		20"			1900	C.&W.I.	Dalton Branch	Tang. & 3° Curve	0.5
5.2	6x8x8	"		4,000		20"			1901	"	" "	Tang. & 3° Curve	0.5
5.3	6x8x8	"		1,225		20"			1903	"	" "	Tang.	0.5
5.4	6x8x8	"		272		20"			1899	"	" "	Tang. & 3° Curve	0.5
5.5	6x8x8	"		1,088		20"			1902	"	" "	Tang. & 3° Curve	0.5
						CR	EOSOTE—(	FULL-CEL	L).				
5.6	7x8x8½	Hewed Sawed	Seasoned	3,850		18 to 33'	30-40	8-10	1910	Penn.	Wooster, O.	Tang. & 3°-5° Cv.	0.8 down

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Indx No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. In-spected	Time Ser-vice	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Refer-erence No.
					OAK—(Black	)—(*Co*	*nti*	*nue*	*d*).						
3.1							1915	15.0	83.7						8.10
3.2							1915	14.0	7.3						8.10
3.3							1915	13.0	32.3						8.10
3.4							1915	12.0	10.6						8.10
3.5							1915	11.0	27.5						8.10
3.6							1915	10.0	32.1						8.10
					OAK—Chestn	ut).									
						UN	TR	EAT	ED.						
4.1							1916	12.0	100.0				7.7		4.11
					OAK—(Mixe	d).									
					ZINC-TANNIN	—(WEL	LH	OU	SE).						
5.1	Sellers	8½x6	Cut	80	Slag		1916	16.0	86.0			Fair		Only few on curve have plates.	17.00
5.2	"	8½x6	"	80	"		1916	15.0	86.0			"		Only few on curve have plates.	17.00
5.3	"	8½x6	"	80	"		1916	13.0	99.7			"			17.00
5.4	"	8½x6	"	80	"		1916	17.0	79.0			"		Only few on curve have plates.	17.00
5.5	"	8½x6	"	80	"		1916	14.0	86.0			"		Only few on curve have plates.	17.00
						CR	EOSOTE	—(	FUL	L-CE	LL).				
5.6	Flat	7x9 & 7x13½	Screw & Cut	100	Stone	14,000,000	1916	6.0	1.6		1.6	Good			20.11

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							OAK—(Pin).						
						CR	EOSOTE—(	FULL-CEL	L).				
6.1				164				6.17	1909	C.B.&Q.	Lines East		
6.2				24				6.17	1910	"	" "		
6.3				3				6.17	1911	"	" "		
6.4				87				6.17	1909	"	Lines West		
6.5				45				6.17	1910	"	" "		
							UNTRE	ATED.					
7.1				54					1909	C.B.&Q.	Lines East		
7.2				24					1910	"	" "		
7.3				30					1909	"	Lnes West		
7.4				15					1910	"	" "		
						ZINC	CHLORIDE	—(BURNE	TT).				
8.1				15				0.50	1910	C.B.&Q.	Hanover, Ill.		
8.2				9				0.50	1910	"	Blanding, Ill.		
8.3				45				0.50	1910	"	Barr, Colo.		
						ZINC-	CREOSOTE	—(CARD).					
9.1				385				Zn. 0.50 Cre. 3.00	1909	"	Lines East		
9.2				201				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines West		
9.3				126				Zn. 0.50 Cre. 3.00	1910	"	Lines East		
9.4				120				Zn. 0.50 Cre. 3.00	1910	"	Lines West		
							OAK—(Red).						
							CRESOL-CA	LCIUM.					
10.1				9					1910	I.C.	Greenville, Miss.		

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Service Conditions—*(Continued)*.							Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					OAK—(Pin).										
					CR	EOSOTE	—(	FUL	L-CE	LL).					
6.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	0						5.20
6.2	All		"	90	Gravel		1916	6.0	0						5.20
6.3	Yes		"	75	"		1916	5.0	0					No tie-plates under joints.	5.20
6.4	"		"	85-90	Cin., Gr., Bt. Cl.		1916	7.0	0						5.20
6.5	"		"	90	Lyons Stone		1916	6.0	0						5.20
						UN	TR	EAT	ED.						
7.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	87.0						5.20
7.2	Yes		"	90	Gravel		1916	6.0	37.5						5.20
7.3	"		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	86.7						5.20
7.4	"		"	85-90	Lyons Stone		1916	6.0	40.0						5.20
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
8.1	All		Cut	90	Sheridan Gravel		1916	6.0	0						5.20
8.2	Yes		"	90	"		1916	6.0	0						5.20
8.3	"		"	90	Lyons Stone		1916	6.0	0					Seasoned 1 year after treatment.	5.20
					ZINC-CREOSO	TE—(C	AR	D).							
9.1	Partly		Cut	75-85-90	Cin., Gr., Stone		1916	7.0	1.3						5.20
9.2	All		"	85-90	"		1916	7.0	0						5.20
9.3	"		"	90	Gravel		1916	6.0	0						5.20
9.4	"		"	90	Lyons Stone		1916	6.0	0						5.20

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
							OAK—(Re	d)—(*Con*	*tinued*	).			
							CREO	SOTE.					
11.1	7x9x8½	Sawed	Peeled	872			Gal. 2.5		1911	B.&O.	Windsor, O.		
11.2	6x8x8	Hewed	Seasoned	4,070					1914	Q.&C.	Cincinnati, O.		
11.3	7x9x8½	"		3,200			32.36	8.70	1914	"	Williamstown, Ky.		
11.4				8					1905	St.L.& S.F.	Pacific, Mo.		
11.5	8x7x9	Sawed	Seasoned	68	Ala.			5.54	1910	T.C.I. &R.	Ensley, Ala.		
						CREO	SOTE—(BE	THELL).					
12.1	6x8x8	Sawed Hewed	Varied	76			6-42		1905	St.L.& S.F.	Pacific, Mo.	Tang.	
						CR	EOSOTE—(	FULL-CEL	L).				
13.1				60				8.34	1910	C.B.&Q.	Lines West		
13.2				60				8.34	1909	"	" "		
13.3				97				8.34	1908	"	Lines East		
13.4				108				8.34	1909	"	" "		
13.5				55				8.34	1910	"	" "		
13.6				25				8.34	1911	"	" "		
13.7	6x8x8	Hewed	Seasoned	50		18 to Rl.		10.90	1911	C.M.& St.P.	Hartford, Wis.	Tang.	0
13.8	6x8x8	"	"	52		18 to Rl.	53.6	10.90	1911	"	" "	"	0
13.9	7x9x8½			50				17.40	1910	Q.&C.	Birmingham, Ala.		
13.10	7x9x8½	Sawed Hewed	Air-seasoned 9 mos.	188	Ky. & Tenn.	17 to Rl.		14.33	1915	L.&N.	Memphis, Tenn.	"	.42 to 0.8

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Ser-vice	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Refer-ence No.
					OAK—(Red)	—(*Cont*	*inu*	*ed*	).						
							CR	EOS	OTE.						
11.1	Shoulder Flange		Cut	90	Gravel	10,586,000	1916	5.0	0			99.9% Good			4.11
11.2							1916	2.0	0			Sound		Under track in street paved with granite blocks—Set in concrete.	47.00
11.3	Economy	7x8¼x½	Screw	85	"		1916	2.0	0			"			47.00
11.4							1916	11.0	25.0					Incomplete record.	30.20
11.5	Goldie		Cut		Sand & Dirt		1915	5.5	25.0	25.0		23.5% Good		51.5% decayed and partly decayed. Tie-plates on curves only.	21.00
						CREOSO	TE	—(B	ETHE	LL).					
12.1	½" Rib.	8¼x6½	Cut	85	Gravel	9,000,000	1916	11.0	10.5					Includes red gum. Gravel put in on cinders in 1914. Tie-plates since 1914.	30.20
					CR	EOSOTE	—(	FUL	L-CE	LL).					
13.1	Yes		Cut	90	Lyons Stone		1916	6.0	0						5.20
13.2	"		"	85-90	Cin., Gr., Bt. Cl.		1916	7.0	0						5.20
13.3	Partly		"	90	Gravel		1916	8.0	0					Tie-plates on curves	5.20
13.4	"		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	0.9						5.20
13.5	All		"	90	Gravel		1916	6.0	0						5.20
13.6	Yes		"	75	"		1916	5.0	0					No tie-plates under joints.	5.20
13.7	Economy	7½x9	Screw	90	"	Heavy	1916	5.0	0			96.1% Good		3.9% partly split.	27.00
13.8	None		Cut	90	"	"	1916	5.0	0			96.1% Good		3.9% " "	27.00
13.9	Rolled St.	7x8¼x½	"	85	Slag		1915	5.0	0			Sound			47.00
13.10	None		"	90	Gr. filled stone	6,255,084	1916	1.0	0			Excellent		Includes other hard-woods. Expected ave. life 14 years.	18.00

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
							OAK—(Re	d)—(*Con*	*tinued*	).			
						CR	EOSOTE—(	GIUSSANI	).				
						(See	Gum Index	No. 5.1).					
14.1	6x8x8	Sawed Hewed	Varied	43			Zn. 0.75-1.0 Cre. 10-15		1905	St.L.& S.F.	Pacific, Mo.		
				CR	EOSO	TE—(L	IVE STEAM	IN SUPE	HEAT	ED COI	LS).		
15.1	6x8x8	Sawed Hewed		24			6-42		1905	St.L.& S.F.	Pacific, Mo.		
						CR	EOSOTE—(	LOWRY.)					
16.1	6x8x8	Sawed	Seasoned	199	Ind.	20"	20.60	7.70	1914	C.I.&L.	Lafayette, Ind.	Tang.	0.5
16.2	6x8x8	Hewed	"	198	"	20"	20.60	7.70	1914	"	" "	"	0.5
16.3	6x8x8	"	"	264		18"	21.75	8.18	1910	N.Y.C.	Cleveland, O.	"	
16.4	6x8x8	"	"	100	Mid. So. States	20"	21.75	8.18	1910	"	West Park, O.	"	
16.5	6x8x8	Sawed Hewed	"	1,981	"	18"	21.75	8.18	1910	"	Cleveland, O.	"	
16.6	6x8x8	Sawed	"	242	"	18"	21.75	8.18	1910	"	Elyria, O.	"	
16.7	6x8x8	Hewed	"	100	"	20"	21.75	8.18	1910	"	Cleveland, O.	"	
16.8	6x8x8	"	"	85	"	20"	21.75	8.18	1910	"	"	Cv. 3° 34'	
16.9	6x8x8	"	"	130	"	20"	21.75	8.18	1910	"	West Park, O.	Tang.	
16.10	6x8x8	"	"	111	"	20"	21.75	8.18	1910	"	"	"	
16.11	6x8x8	Sawed	"	66	"	18"	21.75	8.18	1910	"	Elyria, O.	Cv. 6° 20'	
16.12	6x8x8		"	970	"	20"	21.75	8.18	1910	"	Cleveland, O.	Tang.	
16.13	6x8x8	Hewed	"	1,160	"	22"	21.75	8.18	1910	"	North Storage, O.	"	0

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Index No.	Service Conditions—(*Continued*). Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					OAK—(Red)	—(*Cont*	*inu*	*ed*	).						
					CREOSOTE—(	GIUSSA	NI).								
					(See Gum Index	No. 5.1).									
14.1	⅛" Rib	8¾x6½	Cut	85	Gravel	9,000,000	1916	11.0	41.9					Includes red gum and beech.	30.20
					CRE	OSOTE—(LIVE		ST EAM	IN	SUP	ERH	EAT	ED	COILS).	
15.1	"	8¾x6½	Cut	85	Gravel	9,000,000	1916	11.0	8.3					Includes red gum.	30.20
						CREOSO	TE	—(	LOW	RY).					
16.1	Economy	7	Cut	90	Gravel	5,297,567	1916	2.0	0			Excellent		Treated July 1913 and set June, 1914.	51.00
16.2	"	7	"	90	"	5,297,567	1916	2.0	0			Excellent		Treated July 1913 and set June, 1914.	51.00
16.3	None		"	80	Gravel & Cinders		1916	6.0	0			Good		Includes beech and maple.	14.10
16.4	"		"	80	Stone		1916	6.0	20.			"		Includes beech and maple. Removed because burned.	14.10
16.5			"	80	Cinders		1916	6.0	1.5			"		Includes beech and maple. Removed because of Subway.	14.10
16.6	"		"	80	"		1916	6.0	0			"		Includes beech and maple.	14.10
16.7	"		"	100	Sand		1916	6.0	0			"		Includes beech and maple.	14.10
16.8	"		"	100	"		1916	6.0	0			"		Includes beech and maple.	14.10
16.9	"		"	100	Stone		1916	6.0	0			"		Includes beech and maple.	14.10
16.10	"		"	100	"		1916	6.0	0			"		Includes beech and maple.	14.10
16.11	Shoulder	¼x7x8¾	"	80	Cinder		1916	6.0	0			"		Includes beech and maple.	14.10
16.12	None		"	80	Slag		1916	6.0	10.3					Includes beech and maple. Removed because of track changes.	14.10
16.13	"		"	100	Gravel		1916	6.0	0			Very Good		Includes beech and maple. These ties will last 8 to 10 years more.	14.10

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
							OAK—(Re	d)—(*Con*	*tinued*	).			
							CREOSOTE	—(LOWRY	).				
16.14	6x8x8	Hewed	Seasoned	1,184	Mid. So. States	22"	21.75	8.18	1910	N.Y.C.	Amherst, O.	"	0
16.15	6x8x8	"	"	633	"	22"	21.75	8.18	1910	"	Boy Bridge, O.	"	0
16.16	6x8x8	"	"	1,203	"	22"	21.75	8.18	1910	"	Venice, O.	Curve	0
16.17	6x8x8	"	"	494	"	22"	21.75	8.18	1910	"	Sandusky, O.	Tang.	0
16.18	6x8x8	"	"	3,287	"	22"	21.75	8.18	1910	"	Danbury, O.	"	0
16.19	6x8x8	Sawed Hewed	"	224	"	18"	21.75	8.18	1910	"	Cleveland, O.	"	
16.20	6x8x8	Sawed Hewed	"	1,086	"	20"	21.75	8.18	1910	"	"	"	
16.21	6x8x8	Sawed Hewed	"	6,000	"	18"	21.75	8.18	1910	"	Swanton, O.	"	
16.22	6x8x8	Sawed	"	292	"	18"	21.75	8.18	1910	"	Elyria, O.	Cv. 6° 20'	
16.23	6x8x8	Hewed	"	7,488	"	20¼"	21.75	8.18	1910	"	Mentor, O.	Tang.	
16.24	6x8x8	Sawed	"	741	"	20"	21.75	8.18	1910	"	Erie, Pa.	"	
16.25	6x8x8	Hewed Sawed	"	6,000	"	20"	21.75	8.18	1910	"	Ekhart, Ind.	"	
16.26	6x8x8	Sawed	"	2,997	"	20"	21.75	8.18	1910	"	Lake View, N. Y.	"	0.3
16.27	6x8x8	"	"	1,038	"	20"	21.75	8.18	1910	"	Silver Crk., N.Y.	Cv. & Tang.	various
16.28	6x8x8	"	"	1,512	"	20"	21.75	8.18	1910	"	Ripley, N. Y.	Tang.	0.3
16.29	7x9x8	Hewed	"	46	Minn.	19 to R1	22.80	6.50	1908	N.P.	Sumner, Wash.	"	0

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Service Conditions—*(Continued)*.							Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Refer-ence No.
					OAK—(Red)	—(*Cont*	*inu*	*ed*	).						
					CREOSOTE—(	LOWRY	).								
16.14	None		Cut	80	Gravel		1916	6.0	0			Very Good		Includes beech and maple. These ties will last 8 to 10 years more.	14.10
16.15	"		"	80	"		1916	6.0	0			"		Includes beech and maple. These ties will last 8 to 10 years more.	14.10
16.16	"		"		"		1916	6.0	0			"		Includes beech and maple. These ties will last 8 to 10 years more.	14.10
16.17	"		"	80	"		1916	6.0	0			"		Includes beech and maple. These ties will last 8 to 10 years more.	14.10
16.18	"		"	100	"		1916	6.0	0			"		Includes beech and maple. These ties will last 8 to 10 years more.	14.10
16.19	"		"	80	Stone & Cinders		1916	6.0	0			Good		Includes beech and maple.	14.10
16.20	"			80	Slag		1916	6.0	4.8			"		Removed acct. wreck.	14.10
16.21	"		"	80	Gravel		1916	6.0	0.7			"		Includes beech and maple.	14.10
16.22	Flange	½x4½x6	"	80	Cinders		1916	6.0						Removed acct. adzing and track heaving. 2 ties decayed, 5 sp. killed	
16.23	None		"	80	Stone Since 1915		1916	6.0	0.1						
16.24			"	80	Stone		1916	6.0	0.4		0.4	"		Includes beech and maple.	14.10
16.25	Flange	½x6x8	"	65	Gravel		1916	6.0	0			"		Includes beech and maple.	14.10
16.26			"	80	Stone		1916	6.0	0.1		0.1	"		" " " "	14.10
16.27	Single Flange	6x8	"	100	"		1916	6.0	0.8	0.2	0.1	"		Includes beech and maple 0.5% removed account wreck.	14.10
16.28			"	100	"		1916	6.0	0.4		0.3	"		Includes beech and maple. 0.1% burned.	14.10
16.29	Flat 4 ridges	6x8½x 9/16	"	85	Gravel	Heavy	1916	7.0	0			O. K.			19.00

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing in Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							OAK—(Re	d)—(*Con*	*tinued*	).			
							CRUDE	OIL.					
20.1				3					1911	C.B.&Q.	Baders, Ill.		
						DIAM	OND WOOD	PRESERV	ER.				
20.2	7x9x8	Hewed		500				Gal. 0.15	1907	G.H& S.A.	El Paso		
						FU	EL OIL—(	LOW-PRE	SSUR	E).			
21.1		"	Seasoned	331			Gal. 3.05	8.70	1910	Picatinny Arsenal	Dover, N. J.		
							J. M. LONG'S	LIQUID.					
22.1			"	50				0.135	1910	I.C.	Greenville, Miss.		
			S	EMI R	EFIN	ED OI	L—PARAFF	IN BASE—	(FUL	L-CELL	).		
23.1	6x8x8		"	50	"	18 to Rl.		7.30	1911	C.M.& St.P.	Hartford, Wis.	Tang.	0
23.2	6x8x8		"	50		18 to Rl.		7.30	1911	"	" "		0
					TAR	(20%)	AND CREO	SOTE (80	%)—(	LOWRY).			
24.1		Hewed	Seasoned 14 mos.	1,865	Ark.		7.58	2.52	1912	C.&E.I.	Tuscola, Ill.		
24.2		Sawed	"	955	"		7.58	2.52	1912	"	"		
							TIMBER-	ASHPALT	.				
25.1	7x9x8½	Hewed Sawed	Peeled Seasoned	1,011			Gal.1.75-5.42		1911	B.&O.	Windsor, O.		

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Indx No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					OAK—(Red)	—(*Cont*	*inu*	*ed*	).						
						CR	U	DE	OIL.						
20.1			Cut	75	Gravel		1916	5.0	0						5.20
						DIA	MOND	WO	OD	PRES	ERV	ER.			
20.2	Glendon		"		Slag		1916	9.5	3.4			Good			7.10
					FUEL	OIL—(L	OW-	PR	ESSU	RE).					
21.1	Flat & Flange						1915	5.0	0						22.00
						J. M.	LO	NG'	S LIQ	UID.					
22.1	Economy			75	Dirt		1916	6.0	100.0	100.0			4.75	50% tie-plated.	12.11
				SEMI-	REFINED OIL	—PARA	FFI	N	IN BA	SE—	(FU	LL-CELL).			
23.1	Economy	7½x9	Screw	90	Gravel	Heavy	1916	5.0	0			99% Good		1% partly split.	27.00
23.2	None		Cut	90	"	"	1916	5.0	0			99% Good		1% " "	27.00
					TAR, (20%)	AND CR	EO	SOT	E, (80	%)—	(LO	WRY).			
24.1							1916	4.0	0					Ave. sapwood, 8%.	8.10
24.2							1916	4.0	0					" " 8%.	8.10
						TIMB	ER-	ASP	HAL	T.					
25.1	Shoulder Flange		Cut	90	Gravel	10,586,000	1916	5.0	0			98.7% Good		1.3% are decayed.	4.11

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
							OAK—(Re	d)—(*Con*	*tinued*	).			
						CR	EOSOTE—(	GIUSSANI	).				
						(See	Gum Index	No. 5.1).					
14.1	6x8x8	Sawed Hewed	Varied	43			Zn. 0.75-1.0 Cre. 10-15		1905	St.L.& S.F.	Pacific, Mo.		
				CR	EOSO	TE—(L	IVE STEAM	IN SUPE	HEAT	ED COI	L,S).		
15.1	6x8x8	Sawed Hewed		24			6-42		1905	St.L.& S.F.	Pacific, Mo.		
						CR	EOSOTE—(	LOWRY.)					
16.1	6x8x8	Sawed	Seasoned	199	Ind.	20"	20.60	7.70	1914	C.I.&L.	Lafayette, Ind.	Tang.	0.5
16.2	6x8x8	Hewed	"	198	"	20"	20.60	7.70	1914	"	" "	"	0.5
16.3	6x8x8	"	"	264		18"	21.75	8.18	1910	N.Y.C.	Cleveland, O.	"	
16.4	6x8x8	"	"	100	Mid. So. States	20"	21.75	8.18	1910	"	West Park, O.	"	
16.5	6x8x8	Sawed Hewed	"	1,981	"	18"	21.75	8.18	1910	"	Cleveland, O.	"	
16.6	6x8x8	Sawed	"	242	"	18"	21.75	8.18	1910	"	Elyria, O.	"	
16.7	6x8x8	Hewed	"	100	"	20"	21.75	8.18	1910	"	Cleveland, O.	"	
16.8	6x8x8	"	"	85	"	20"	21.75	8.18	1910	"	"	Cv. 3° 34'	
16.9	6x8x8	"	"	130	"	20"	21.75	8.18	1910	"	West Park, O.	Tang.	
16.10	6x8x8	"	"	111	"	20"	21.75	8.18	1910	"	"	"	
16.11	6x8x8	Sawed	"	66	"	18"	21.75	8.18	1910	"	Elyria, O.	Cv. 6° 20'	
16.12	6x8x8		"	970	"	20"	21.75	8.18	1910	"	Cleveland, O.	Tang.	
16.13	6x8x8	Hewed	"	1,160	"	22"	21.75	8.18	1910	"	North Storage, O.	"	0

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Index No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					OAK—(Red)	—(*Cont*	*inu*	*ed*	).						
					CREOSOTE—(	GIUSSA	NI).								
					(See Gum Index	No. 5.1).									
14.1	½" Rib	8½x6½	Cut	85	Gravel	9,000,000	1916	11.0	41.9					Includes red gum and beech.	30.20
					CRE	OSOTE—(LIVE	ST EAM	IN	SUP	ERH	EAT	ED	COILS).			
15.1	"	8½x6½	Cut	85	Gravel	9,000,000	1916	11.0	8.3					Includes red gum.	30.20
						CREOSO	TE	—(	LOW	RY).					
16.1	Economy	7	Cut	90	Gravel	5,297,567	1916	2.0	0			Excellent		Treated July 1913 and set June, 1914.	51.00
16.2	"	7	"	90	"	5,297,567	1916	2.0	0			Excellent		Treated July 1913 and set June, 1914.	51.00
16.3	None		"	80	Gravel & Cinders		1916	6.0	0			Good		Includes beech and maple.	14.10
16.4	"		"	80	Stone		1916	6.0	20.			"		Includes beech and maple. Removed because burned.	14.10
16.5			"	80	Cinders		1916	6.0	1.5			"		Includes beech and maple. Removed because of Subway.	14.10
16.6	"		"	80	"		1916	6.0	0			"		Includes beech and maple.	14.10
16.7	"		"	100	Sand		1916	6.0	0			"		Includes beech and maple.	14.10
16.8	"		"	100	"		1916	6.0	0			"		Includes beech and maple.	14.10
16.9	"		"	100	Stone		1916	6.0	0			"		Includes beech and maple.	14.10
16.10	"		"	100	"		1916	6.0	0			"		Includes beech and maple.	14.10
16.11	Shoulder	½x7x8½	"	80	Cinder		1916	6.0	0			"		Includes beech and maple.	14.10
16.12	None		"	80	Slag		1916	6.0	10.3					Includes beech and maple. Removed because of track changes.	14.10
16.13	"		"	100	Gravel		1916	6.0	0			Very Good		Includes beech and maple. These ties will last 8 to 10 years more.	14.10

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
							OAK—(Re	d)—(*Con*	*tinued*	).			
							CREOSOTE	—(LOWRY	).				
16.14	6x8x8	Hewed	Seasoned	1,184	Mid. So. States	22"	21.75	8.18	1910	N.Y.C.	Amherst, O.	"	0
16.15	6x8x8	"	"	633	"	22"	21.75	8.18	1910	"	Boy Bridge, O.	"	0
16.16	6x8x8	"	"	1,203	"	22"	21.75	8.18	1910	"	Venice, O.	Curve	0
16.17	6x8x8	"	"	494	"	22"	21.75	8.18	1910	"	Sandusky, O.	Tang.	0
16.18	6x8x8	"	"	3,287	"	22"	21.75	8.18	1910	"	Danbury, O.	"	0
16.19	6x8x8	Sawed Hewed	"	224	"	18"	21.75	8.18	1910	"	Cleveland, O.	"	
16.20	6x8x8	Sawed Hewed	"	1,086	"	20"	21.75	8.18	1910	"	"	"	
16.21	6x8x8	Sawed Hewed	"	6,000	"	18"	21.75	8.18	1910	"	Swanton, O.	"	
16.22	6x8x8	Sawed	"	292	"	18"	21.75	8.18	1910	"	Elyria, O.	Cv. 6° 20'	
16.23	6x8x8	Hewed	"	7,488	"	20¼"	21.75	8.18	1910	"	Mentor, O.	Tang.	
16.24	6x8x8	Sawed	"	741	"	20"	21.75	8.18	1910	"	Erie, Pa.	"	
16.25	6x8x8	Hewed Sawed	"	6,000	"	20"	21.75	8.18	1910	"	Elkhart, Ind.	"	
16.26	6x8x8	Sawed	"	2,997	"	20"	21.75	8.18	1910	"	Lake View, N. Y.	"	0.3
16.27	6x8x8	"	"	1,038	"	20"	21.75	8.18	1910	"	Silver Crk., N.Y.	Cv. & Tang.	various
16.28	6x8x8	"	"	1,512	"	20"	21.75	8.18	1910	"	Ripley, N. Y.	Tang.	0.3
16.29	7x9x8	Hewed	"	46	Minn.	19 to Rl	22.80	6.50	1908	N.P.	Sumner, Wash.	"	0

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Service Conditions—*(Continued)*.							Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					OAK—(Red) —(*Cont*		*inu*	*ed*	).						
					CREOSOTE—(	LOWRY	).								
16.14	None		Cut	80	Gravel		1916	6.0	0			Very Good		Includes beech and maple. These ties will last 8 to 10 years more.	14.10
16.15	"		"	80	"		1916	6.0	0			"		Includes beech and maple. These ties will last 8 to 10 years more.	14.10
16.16	"		"		"		1916	6.0	0			"		Includes beech and maple. These ties will last 8 to 10 years more.	14.10
16.17	"		"	80	"		1916	6.0	0			"		Includes beech and maple. These ties will last 8 to 10 years more.	14.10
16.18	"		"	100	"		1916	6.0	0			"		Includes beech and maple. These ties will last 8 to 10 years more.	14.10
16.19	"		"	80	Stone & Cinders		1916	6.0	0			Good		Includes beech and maple.	14.10
16.20	"			80	Slag		1916	6.0	4.8			"		Removed acct. wreck.	14.10
16.21	"		"	80	Gravel		1916	6.0	0.7			"		Includes beech and maple.	14.10
16.22	Flange	½x4½x6	"	80	Cinders		1916	6.0							
16.23	None		"	80	Stone Since 1915		1916	6.0	0.1					Removed acct. adzing and track heaving. 2 ties decayed, 5 sp. killed	
16.24			"	80	Stone		1916	6.0	0.4		0.4	"		Includes beech and maple.	14.10
16.25	Flange	½x6x8	"	65	Gravel		1916	6.0	0			"		Includes beech and maple.	14.10
16.26			"	80	Stone		1916	6.0	0.1		0.1	"		" " " "	14.10
16.27	Single Flange	6x8	"	100	"		1916	6.0	0.8	0.2	0.1	"		Includes beech and maple 0.5% removed account wreck.	14.10
16.28			"	100	"		1916	6.0	0.4		0.3	"		Includes beech and maple. 0.1% burned.	14.10
16.29	Flat 4 ridges	6x8½x 9/16	"	85	Gravel	Heavy	1916	7.0	0			O. K.			19.00

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							OAK—(Re	d)—(*Con*	*tinued*	).			
						CREOS	OTE—(NO	STEAM).					
17.1			Seasoned 12 mos.	200	La.			7.00	1910	St.L.& S.W.	Texas		
17.2			Seasoned	200	Texas			8.00	1911	"	Texarkana, Tex.		
17.3		Sawed Hewed	Varied	83			11-30.		1905	St.L.& S.F.	Pacific, Mo.		
						CR	EOSOTE—(	RUEPING	).				
18.1		Sawed	Seasoned	52				5.00	1907	A.T.& S.F.	Plevna, Kan.		
18.2				15					1911	C.B.&Q.	Baders, Ill.		
18.3	6x8x8	Hewed	"	50		18 to Rl.		5.30	1911	C.M.& St.P.	Hartford, Wis.	Tang.	0.
18.4	6x8x8	"	"	50		18 to Rl.		5.30	1911	"	" "	"	0.
18.5	6x8x8	"	"	274				5.00	1910	I.C.	Bloomington, Ill.		
18.6	6x8x8	Sawed Hewed	"	274				5.00	1909	"	Fulton, Ky.		
18.7	6x8x8	Hewed	"	274				5.00	1910	"	Greenville, Miss.		
18.8	6x8x8	Sawed Hewed	"	274				5.00	1909	"	Kankakee, Ill.		
18.9	6x8x8	Hewed	Seasoned 2 years	752			12.6		1906	St.L.& S.F.	St. Clair, Mo.		
18.10	6x8x8	Sawed Hewed	Varied	40			7-21.5		1905	"	Pacific, Mo.	Tang.	
18.11	7x8x8½	Sawed Hewed	Seasoned	3,789		18 to 33'	22.5	6.80	1907	Penn.	Scio, O	1.5° Cv. & Tang.	0.1
						CRE	OSOTE AND	CRUDE O	IL.				
19.1				3					1911	C.B.&Q.	Baders, Ill.		

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Service Conditions—*(Continued)*.						Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					OAK—(Red)	—(*Cont*	*inu*	*ed*	).						
					CR	EOSOTE	—(	NO	STEA	M).					
17.1							1916	6.0	0			Good		Seasoned 10 mos. after treatment, 7% checked, rail-cut and split.	35.00
17.2							1916	6.0	0					8.5% are checked.	35.00
17.3	⅛" Rib	8½x6½	Cut	85	Gravel	9,000,000	1916	11.0	13.3					Includes red gum.	30.20
						CREOSO	TE	—(R	UEP	ING).					
18.1		7½x9	Cut	90	Rock	4,904,161	1916	9.0	0						45.10
18.2	Yes			75	Gravel		1916	5.0	0					No tie-plates under joints.	5.20
18.3	Flat St.	6x8	Screw	90	"	Heavy	1916	5.0	0			95% Good		5% partly split.	27.00
18.4	None		Cut	90	"	"	1916	5.0	0			95% Good		5% partly split.	27.00
18.5	Sellers	6x8	"	75	"		1916	6.0	0			95% Good		50% tie-plated.	12.11
18.6		6x8	"	90	"		1916	7.0	5.5		5.5			Ties worn out and split acct. badly creeping track.	12.11
18.7	Economy	6x8	"	75	Gravel Since 1912		1916	6.0	0.7		0.7				12.11
18.8	"	6x8	"	90	Stone		1916	7.0	9.1					Removed account derailment: 50% tie-plated.	12.11
18.9	⅛" Rib .	8½x6½	"	85	Chats	8.300,000	1916	10.0	0.1					Chats Ballast put in on gravel in 1913. Rails changed from 75 to 85 in 1909. Tie plates since 1914.	30.20
18.10	"	8½x6½	"	85	Gravel	9,000,000	1916	11.0	10.0					Includes red gum, gravel put in cinders in 1914. Tie-plates since 1914.	30.20
18.11	Flat	6x9	C. & S.	100	Stone		1916	9.0	49.0		49.0	Sound			20.11

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							OAK—(Re	d)—(*Con*	*tinued*	).			
							CRUDE	OIL.					
20.1				3					1911	C.B.&Q.	Baders, Ill.		
						DIAM	OND WOOD	PRESERV	ER.				
20.2	7x9x8	Hewed		500				Gal. 0.15	1907	G.H& S.A.	El Paso		
						FU	EL OIL—(	LOW-PRE	SSUR	E).			
21.1		"	Seasoned	331			Gal. 3.05	8.70	1910	Picatinny Arsenal	Dover, N. J.		
							J. M. LONG'S	LIQUID.					
22.1			"	50				0.135	1910	I.C.	Greenville, Miss.		
			S	EMI R	EFIN	ED OI	L—PARAFF	IN BASE—	(FUL	L-CELL	).		
23.1	6x8x8		"	50	"	18 to Rl.		7.30	1911	C.M.& St.P.	Hartford, Wis.	Tang.	0
23.2	6x8x8		"	50		18 to Rl.		7.30	1911	"	" "		0
					TAR	(20%)	AND CREO	SOTE (80	%)—(	LOWRY).			
24.1		Hewed	Seasoned 14 mos.	1,865	Ark.		7.58	2.52	1912	C.&E.I.	Tuscola, Ill.		
24.2		Sawed	"	955	"		7.58	2.52	1912	"	"		
							TIMBER-	ASHPALT	.				
25.1	7x9x8½	Hewed Sawed	Peeled Seasoned	1,011			Gal.1.75-5.42		1911	B.&O.	Windsor, O.		

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					OAK—(Red)	—(*Cont*	*inu*	*ed*	).						
						CR	U	DE	OIL.						
20.1			Cut	75	Gravel		1916	5.0	0						5.20
					DIA	MOND	WO	OD	PRES	ERV	ER.				
20.2	Glendon		"		Slag		1916	9.5	3.4			Good			7.10
					FUEL	OIL—(L	OW-	PR	ESSU	RE).					
21.1	Flat & Flange						1915	5.0	0						22.00
						J. M.	LO	NG'	S LIQ	UID.					
22.1	Economy			75	Dirt		1916	6.0	100.0	100.0			4.75	50% tie-plated.	12.11
				SEMI-	REFINED OIL	—PARA	FFI	N	IN BA	SE—	(FU	LL-CELL).			
23.1	Economy	7½x9	Screw	90	Gravel	Heavy	1916	5.0	0			99% Good		1% partly split.	27.00
23.2	None		Cut	90	"	"	1916	5.0	0			99% Good		1% " "	27.00
					TAR, (20%)	AND CR	EO	SOT	E, (80	%)—	(LO	WRY).			
24.1							1916	4.0	0					Ave. sapwood, 8%.	8.10
24.2							1916	4.0	0					" " 8%.	8.10
						TIMB	ER-	ASP	HAL	T.					
25.1	Shoulder Flange		Cut	90	Gravel	10,586,000	1916	5.0	0			98.7% Good		1.3% are decayed.	4.11

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Cross-Tie Records—Service Tests—*(Continued)*.

DESCRIPTION OF MATERIAL.									SERVICE CONDITIONS				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							OAK—(Re	d)—(*Con*	*tinued*	).			
							UNTRE	ATED.					
26.1				15					1910	C.B.&Q.	Lines West		
26.2	6x8x8		Seasoned 10 mos.	50	Tenn.	18 to Rl.			1911	C.M.& St.P.	Hartford, Wis.	Tang.	0.
26.3	6x8x8		"	50	"	18 to Rl.			1911	"	" "	"	0.
26.4				50					1908	C.B.&Q.	Lines East		
26.5				108					1909	"	" "		
26.6				25					1910	"	" "		
26.7				59					1909	"	Lines West		
26.8	7x8x8½			1,900		18 to 33'			1907	Penn.	Scio., O.	2° Curve & Tang.	0.1
						ZINC	CHLORIDE	—(BURNE	TT).				
27.1	6x8x8	Hewed		97,920	Ill. (Generally)	18 to Rl.		0.50	1907	C.&A.	Iles, Ill.	34 mile Tang.	0.3 (max.)
27.2				109				0.50	1909	C.B.&Q.	Lines East		
27.3				47				0.50	1910	"	" "		
27.4				20				0.50	1911	"	" "		
27.5				60				0.50	1910	"	Lines West		
27.6				56				0.50	1909	"	" "		
27.7				550				0.33	1900	"	Mystic, S. D.	12° Cv. & Tang.	0.3
27.8	6x8x8	Sawed Hewed		274				0.50	1909	I.C.	Kankakee, Ill.		
27.9	6x8x8	Sawed Hewed		274				0.50	1909	"	Fulton, Ky.		
27.10	6x8x8	Sawed Hewed		274				0.50	1910	"	Greenville, Miss.		
27.11	6x8x8	Sawed Hewed	Seasoned	274				0.50	1910	"	Bloomington, Ill.		
27.12	6x8x8	Hewed	Steamed Seasoned	176		18 to Rl.	1.50	0.50	1911	C.M.& St.P.	Madison, Wis.	Tang.	0

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Indx No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. In-spected	Time Ser-vice	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Refer-ence No.
					OAK—(Red)	—(*Cont*	*inu*	*ed*	).						
						UN	TR	EAT	ED.						
26.1	Yes		Cut	90	Lyons Stone		1916	6.0	40.0						5.20
26.2	Economy	7¼x9	Screw	90	Gravel	Heavy	1916	5.0	2.0	2.0		38% Good		57% partly decayed. 3% partly split.	27.00
26.2	None		Cut	90	"	"	1916	5.0	2.0	2.0		38% Good		3% partly split. Tie-plates on curves only.	27.00
26.4	Yes		"	90	"		1916	8.0	92.0						5.20
26.5	Partly		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	94.5						5.20
26.6	Yes		"	90	Gravel		1916	6.0	80.0				5.0		5.20
26.7	"		"	85-90	Cin., Gr., Bt. Cl.		1915	6.0	100.0						
26.8	Flat	6x9	"	100	Stone		1914	7.0	100.0				5.75	All out in 7 years.	20.11
					ZINC CHLORI	DE—(B	UR	NE	TT).						
27.1	Few		Cut	80	Gr. and Cinders		1916	9.0	21.0	21.0		Fair			50.00
27.2	Partly*		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	7.3						5.20
27.3	All		"	90	Gravel		1916	6.0	0						5.20
27.4	Yes		"	75	"		1916	5.0	0					No tie-plates under joints.	5.20
27.5	"		"	90	Lyons Stone		1916	6.0	1.7						5.20
27.6	"		"	85-90	Cin., Gr., Bt. Cl.		1916	7.0	0						5.20
27.7	"		"	75	Lime Stone & Blk. Hills Dirt		1916	16.0	23.1	22.5				Outside rail on curves changed 1909. 0.6% removed for experimental purposes.	5.20
27.8	Sellers	6x8	"	90	Stone		1916	7.0	24.8					50% tie-plated. Removed acct. derailment.	12.11
27.9	"	6x8	"	90	Gravel		1916	7.0	69.3		69.3			Removed acct. split and wear.	12.11
27.10	"	6x8	"	75	Gr. Since 1912		1916	6.0	14.2		14.2			50% tie-plated. Ties checked and spike worn.	12.11
27.11	"	6x8	"	75	Gravel		1916	6.0	0					50% tie-plated.	12.11
27.12	None		"	75	"	Average	1916	5.0	9.1			13.6% badly rail-cut		Few are slightly rotten and split. All rail-cut ⅛ to ⅓ in.	6.11

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
							OAK—(Re	d)—(*Con*	*tinued*	).			
27.13	6x8x8		Seasoned	50		18 to Rl.		0.50	1911	C.M.& St.P.	Hartford, Wis.	Tang.	0
27.14	6x8x8		"	50		18 to Rl.		0.50	1911	"	" "	"	0
27.15	6x8x8		"	208		18 to Rl.		0.50	1911	"	" "	"	0
27.16	6x8x8		"	52		18 to Rl.		0.50	1911	"	" "	"	0
27.17	6x8x8	Hewed	Steamed Seasoned	300		22"	1.50	0.50	1907	C.M.& St.P.	McLaughlin, S. D.	Tang.	0.1
27.18	6x8x8	"	Seasoned	373	Mo.	19 to Rl.		0.50	1913	"	Byron, Ill.	"	0
27.19	6x8x8	"	Steamed Unseasoned	432	"	19 to Rl.		0.50	1913	"	"	"	0
27.20	6x8x8	Sawed	Seasoned 12 mos.	672	Ky.		1.453	0.539	1912	C.&E.I.	Tuscola, Ill.		
27.21	6x8x8	Hewed	"	769	"		1.453	0.539	1912	"	" "		
27.22	6x8x8	Sawed	"	724	"		0.919	0.346	1912	"	" "		
27.23	6x8x8	Hewed	"	621	"		0.919	0.346	1912	"	" "		

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Index No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					OAK—(Red)	—(*Cont*	*inu*	*ed*	).						
27.13	Economy	7½x9	Screw	90	"	Heavy	1916	5.0	0			95% Good		5% partly split.	27.00
27.14	None		Cut	90	"	"	1916	5.0	0			95% Good		5% " "	27.00
27.15	Economy	7½x9	Screw	90	"	"	1916	5.0	0			97.5% Good		1½% partly decayed. 1% partly split.	27.00
27.16	M.I.Rib.	6x8	Cut	90	"	"	1916	5.0	0			97.5% Good		1½% partly decayed. 1% partly split.	27.00
27.17	None		Cut	85	Gravel	5,562,600	1916	9.0	10.0	10.0				90 lb. rail placed in 1916. None removed until 1913.	6.11
27.18	"		"	100	"	Heavy	1916	3.0	0			Good		Many of these ties much smaller. Should have been called No. 2.	6.11
27.19	"			100	"	"	1916	3.0	0			Good		Many of these ties much smaller. Should have been called No. 2.	6.11
27.20							1916	4.0	0					No steaming. Avg. sapwood 10%. Treated ties stacked in open piles 24 days before setting. Are an open grain variety of oak.	8.10
27.21							1916	4.0	0					No steaming. Avg. sapwood 10%. Treated ties stacked in open piles 24 days before setting. Are an open grain variety of oak.	8.10
27.22							1916	4.0	0					Avg. sapwood 20%. Treated ties stacked in open piles 24 days before setting. No steaming.	8.10
27.23							1916	4.0	0					Avg. sapwood 20%. Treated ties stacked in open piles 24 days before setting. No steaming.	8.10

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							OAK—(Re	d)—(*Con*	*tinued*	).			
						ZINC	CHLORIDE	—(BURNE	TT).				
27.24	7x9x8½	Sawed Hewed	Seasoned 9 mos.	237	Ky. & Tenn.	17 to Rl.	1.776	0.48	1915	L.&N.	Memphis, Tenn.	Tang.	.42 to .8
						ZINC	CREOSOTE	—(CARD).					
28.1				545				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
28.2				102				Zn. 0.50 Cre. 3.00	1908	"	" "		
28.3				220				Zn. 0.50 Cre. 3.00	1910	"	" "		
28.4				110				Zn. 0.50 Cre. 3.00	1911	"	" "		
28.5				292				Zn. 0.50 Cre. 3.00	1909	"	Lines West		
28.6				211				Zn. 0.50 Cre. 3.00	1910	"	" "		
28.7	7x9x8½	Sawed Hewed	Peeled Seasoned	1,237				Zn. 0.50 Cre. 2.00	1911	B.&O.	Windsor, O.		
28.8	6x8x8		Seasoned	50		18 to Rl.		Zn. 0.37 Cre. 3.06	1911	C.M.& St.P.	Hartford, Wis.	Tang.	0
28.9	6x8x8		"	50		18 to Rl.		Zn. 0.37 Cre. 3.06	1911	"	" "	"	0
					ZINC-	CREO	SOTE (*TW	O MOVE	MEN	T).			
29.1	6x8x8	Hewed	Seasoned	50		18 to Rl.		Emulsion 15.3	1911	C.M.& St.P.	Hartford, Wis.	Tang.	0
29.2	6x8x8	"	"	50		18 to Rl.		Emulsion 15.3	1911	"	" "	"	0
							ZINC-CREO	SOTE.					
30.1	7x8x8	"	"	250				Zn. 4% C. 12%	1906	G.H.& S.A.	Louisiana		

*Special Treatment.

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Indx No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. In-spected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					OAK—(Red)	—(*Cont*	*inue*	*ed*	).						
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
27.24	None		Cut	90			1916	4.0	0			Excellent		Includes other hardwoods. Ave. life, 11 years expected.	18.00
					Zl	NC CRE	OS	OT	E—(C	ARD	).				
28.1	Partly		Cut	75-85-90	Cin., Gr. Bt. Cl.		1916	7.0	4.4						5.20
28.2	"		"	90	Gravel		1916	8.0	1.0					Tie-plates on curves.	5.20
28.3	All		"	90	"		1916	6.0	0.5						5.20
28.4	Yes		"	75	"		1916	5.0	0					No tie-plates under joints.	5.20
28.5	"		"	85-90	Cin., Gr., Bt. Cl.		1916	7.0	0.3						5.20
28.6	"		"	90	Lyons Stone		1916	6.0	0						5.20
28.7	Shoulder Flange		"	90	Gravel	10,586,000	1916	5.7	0			99.4% Good		0.6% decayed.	4.11
28.8	None		"	90	"	Heavy	1916	5.0	0			92% Good		8% partly split.	27.00
28.9	"		"	90	"	"	1916	5.0	0			92% Good		8% partly split.	27.00
					ZINC-	CREOSO	TE	—(*	TWO	MOV	EME	NT).			
29.1	Economy	7½x9	Screw	90	Gravel	Heavy	1916	5.0	0			95% Good		3% Zinc Chloride Solution and Creosote. 5% partly split.	27.00
29.2	None		Cut	90	"	"	1916	5.0	0			95% Good		5% partly split.	27.00
						ZINC-	CRE	OS	OTE.						
30.1	I. & W.		Cut	80	Gravel		1916	10.0	42.8						7.10

*Special treatment.

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							OAK—(White). CREOSOTE.						
31.1				15					1910	C.B.&Q.	Hanover, Ill.		
31.2				10					1910	"	Blanding, Ill.		
31.3				15					1910	"	Barr, Colo.		
						CR	EOSOTE—(	FULL-CEL	L).				
32.1	7x9x8.5	Hewed		50		20"			1910	Q.&C.	Birmingham		
						CR	EOSOTE—(	LOWRY.)					
33.1	6x8x8	"	Seasoned	131	Ind.	20"	22.2	8.3	1914	C.I.&L.	Lafayette, Ind.	Tang.	0.5
34.1			Seasoned 11 mos.	200	Ark.			8.0	1910	St.L.& S.W.	Texarkana, Tex.		
							UNTREATED.						
35.1		Hewed		1,470	Mo.				1912	C.&E.I.	Tuscola, Ill.		
35.2				56					1909	C.B.&Q.	Lines East		
35.3				25					1910	"	" "		
35.4				20					1909	"	Lines West		
35.5				24					1910	"	" "		
35.6	7x8x8½	Sawed		65,725	N. Y. & Penn.	21"			1902	P.S.&N.	New York	42% Curve 58% Tang.	1.3
35.7	7x8x8½		Seasoned	20,219	"	21"			1902	"	" "	50% Curve 50% Tang.	1.5
35.8	7x7x8½	Hewed	"	137,000		18 to Rl.			1904-06	Wash. Term.C.	Washington, D.C.		
35.9	6x8x8	Sawed Hewed	"	546					1909	I.C.	Kankakee, Ill.		
35.10	6x8x8	Sawed Hewed	"	274					1910	"	Bloomington, Ill.		

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results: Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					OAK-(White).		CR	EOS	OTE.						
31.1	Yes		Cut	90	Sheridan Gravel		1916	6.0	0						5.20
31.2	"		"	90	"		1916	6.0	0						5.20
31.3	"		"	90	Lyons Stone		1916	6.0	0						5.20
					CR	EOSOTE	—(	FUL	L-CE	LL).					
32.1	Rolled St.	7x8½x½		85	Slag		1915	5.0	0			Sound			47.00
						CREOSO	TE	—(	LOW	RY).					
33.1	Economy		Cut	90	Gravel	5,297,567	1916	2.0	0			Excellent			51.00
					CR	EOSOTE	—(	NO	STEA	M).					
34.1							1916	6.0	3.0		3.0	Good		6% are checked, split or rail-cut.	35.00
						UN	TR	EAT	ED.						
35.1							1916	4.0	0						8.10
35.2	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	12.5					20% Ave. sapwood.	5.20
35.3	Yes		"	90	Gravel		1916	6.0	20.0						5.20
35.4	"		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	10.0						5.20
35.5	"		"	85-90	Stone, Bt. Clay		1916	6.0	0						5.20
35.6	Wal-haupter	½x6x8½	"	85	Slag	4,000,000	1916	14.0	70.0	70.0		Good		Renewals began 1911. Includes Yellow Pine.	1.761
35.7	"	½x6x8½	"	85	Gr. and Slag	4,000,000	1916	14.0	60.0	60.0		Fairly Good		Includes Yellow Pine.	1.761
35.8	P. R. R. Flat bot.	7x10½	"	85	Stone Cin.	1,460,000	1916	10-12	96.3					Traffic is estimated.	4.11
35.9	Economy	6x8	"	90	Stone		1916	7.0	50.7	20.3				50% tie-plated 30.4% removed acct. derailment.	12.11
35.10	Sellers	6x8	"	75	Gravel		1916	6.0	0					50% tie-plated.	12.11

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							OAK—(White)—(Continued).						
35.11	6x8x8	Sawed Hewed	Seasoned	274					1910	I.C.	Bloomington, Ill.		
35.12	6x8x8	Sawed Hewed	"	274					1909	"	Fulton, Ky.		
35.13	6x8x8	Sawed Hewed	"	274					1909	"	" "		
35.14	6x8x8			50		19 to 33"			1907	C.&N.W.	Janesville, Wis.		
35.15	7x9x8½		"	760					1911	B.&O.	Windsor, O.		
35.16	7x9x8	Hewed		75	South-West	17 to Rl.			1911	C.M.& St.P.	Cowgill, Mo.	2° Curve	
35.17	6x8x8	"		280	Ark.	18 to Rl.			1911	C.M.& St.P.	Braymer, Mo.	Tang.	0
35.18	6x8x8			500	Kan.	18 to Rl.			1903	"	Washington, Ia.	"	0
35.19	8x7x9	Sawed	"	34	Ala.				1910	T.C.I.&R.	Ensley, Ala.		
						ZINC	CHLORIDE	—(BURNETT).					
36.1				15				0.50	1910	C.B.&Q.	Hanover, Ill.		
36.2				10				0.50	1910	"	Blanding, Ill.		
36.3				15				0.50	1910	"	Barr, Colo.		
						ZINC-	CREOSOTE	—(CARD).					
37.1				162				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
37.2				351				Zn. 0.50 Cre. 3.00	1908	"	Chicago, Div.		
37.3				75				Zn. 0.50 Cre. 3.00	1910	"	Lines East		
37.4				92				Zn. 0.50 Cre. 3.00	1909	"	Lines West		
37.5				60				Zn. 0.50 Cre. 3.00	1910	"	" "		

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Indx No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. In-spected	Time Ser-vice	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Refer-ence No.
					OAK–(White)—(*Co*		*nti*	*nu*	*ed*).						
35.11	Sellers	6x8	Cut	75	Gravel		1916	6.0	10.9	10.9				50% tie-plated.	12.11
35.12	"	6x8	"	90	"		1916	7.0	65.0	65.0				Ties worn out and split acct. badly creeping track.	12.11
35.13	"	6x8	"	90	"		1916	7.0	38.0	38.0				Ties worn out and split acct. badly creeping track.	12.11
35.14	None		"	90	"		1916	8.5	38.0			62% Partly decayed			26.00
35.15	Shoulder Flange		"	90	"	10.586,000	1916	5.0	0			95.2% Good		4.8% are decayed.	4.11
35.16	None		"	85	Burnt Clay	Heavy	1916	5.0	2.7			77.3% Good			6.11
35.17	"		"	85	"	"	1916	5.0	0			76.4% Good			6.11
35.18	"		"	85	Gravel	"	1916	13.0	67.0			24.6% Fair		Ties removed mostly acct. decay.	6.11
35.19	Goldie		"		Sand & Dirt		1915	5.5	20.6	20.6				Tie-plates on curves only. 64.7% decayed or partly decayed.	21.00
					ZINC CHLORI		DE	—(	BURN	ETT	).				
36.1	All		Cut	90	Sheridan Gravel		1916	6.0	0						5.20
36.2	"		"	90	"		1916	6.0	0						5.20
36.3	"		"	90	Lyons Stone		1916	6.0	0						5.20
					ZINC-CREOSO	TE—(C	AR	D).							
37.1	Partly		Cut	75-85-90			1916	7.0	4.3						5.20
37.2	All		"	90	Gravel		1916	8.0	6.6						5.20
37.3	"		"	90			1916	6.0	0						5.20
37.4	"		"	85-90			1916	7.0	2.2						5.20
37.5	"		"	90	Lyons Stone		1916	6.0	0						5.20

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							OHIA.						
							UNTRE	ATED.					
1.1		Sawed	Seasoned	108					1910	A.T.& S.F.	Hutchinson Cut-off		
1.2		Hewed	"	132					1910	"	H. Cut-Off		
							PINE—(L	oblolly).					
						CR	EOSOTE—(	LOWRY.)					
1.1	7x9x8	Hewed	Seasoned	45	Minn.	19 to Rl.	22.8	6.5	1908	N.P.	Sumner, Wash.	Tang.	0
							PINE—(Ja	ck).					
							CREO	SOTE.					
						(See	Pine, Index	No. 25.1).					
						CR	EOSOTE—(	FULL-CEL	L).				
2.1	7x9x8½	"	Seasoned 6 mos.	1,000			35.0	10.0	1907	Ga.R.R.	Union Point, Ga.	Tang.	
2.2	7x9x8½	"	Seasoned 10 mos.	1,000			35.0	10.0	1907	"	Barnett, Ga.	"	
2.3	8x9x8½	"		50		20"		17.4	1910	Q.&C.	Birmingham, Ala.		
2.4				88				22.19	1909	C.B.&Q.	Lines East		
2.5				50				22.19	1910	"	" "		
2.6				40				22.19	1909	"	Lines West		
2.7				31				22.19	1910	"	" "		
2.8	7x8x8½	Sawed Hewed	Seasoned	2,743		18 to 33'	30-40	8-10	1910	Penn.	Wooster, O.	Tang. & 3°-5°Cv.	0.8 down
						CREOS	OTE—(NO	STEAM).					
3.1			Seasoned 3 mos.	292	Ark.			12.0	1910	St.L.& S.W.	Texarkana, Tex.		

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Indx No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. In-spected	Time Service	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Refer-erence No.
					OHIA.										
						UN	TR	EAT	ED.						
1.1		7½x9	Screw	90	Rock		1916	6.0	0						45.10
1.2		7½x9	"	90	"		1916	6.0	0						45.10
					PINE—(Jack	).									
						CREOSO	TE	—(	LOW	RY).					
1.1	Flat 4 ridges	6x8¼x 9/16	Cut	85	Gravel	Heavy	1915	7.0	0			O. K.			19.00
					PINE—(Lobl	olly).									
							CR	EOS	OTE.						
						(See P	ine,	Inde	x No.	25.1).					
						CR	EOSOTE	—(	FUL	L-CE	LL).				
2.1	None		Cut	65	Cinders	900,000	1916	9.0	3.3					In passing siding.	34.00
2.2	"		"	65	"	300,000	1916	9.0	2.3					Sap Pine. In passing siding.	34.00
2.3	Rolled St.	7x8½x½	"	85	Slag		1915	5.0	0			Sound			47.00
2.4	Partly		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	0						5.20
2.5	All		"	90	Gravel		1916	6.0	0						5.20
2.6	Yes		"	85-90	Cin., Gr., Bt. Cl.		1916	7.0	0						5.20
2.7	"		"	90	Lyons Stone		1916	6.0	0						5.20
2.8	"	7x9 to 7x13½	C. & S.	100	Stone	14,000,000	1916	6.0	62.0		62.0	Good			20.11
						CR	EOSOTE	—(	NO	STEA	M).				
3.1							1916	6.0	0.7		0.7	Good		4.5% are rail-cut, check-ed and split.	35.00

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							PINE—(L	oblolly)—	(*Con*	*tinued*).·			
						CRE	OSOTE—(S	TEAMED).					
4.1			Unseasoned	299	Texas			12.0	1910	St.L.& S.W.	Texarkana, Tex.		
						CR	EOSOTE—(	RUEPING	).				
						See	Pine Index	Nos. 36.1-	36.12).				
5.1	6x8x8	Hewed Sawed	Seasoned	274				5.00	1909	I.C.	Fulton, Ky.		
5.2	6x8x8	Hewed Sawed	"	274				5.00	1910	"	Greenville, Miss.		
5.3	6x8x8	Hewed Sawed	"	273				5.00	1909	"	Kankakee, Ill.		
5.4	6x8x8	Hewed Sawed	"	274				5.00	1910	"	Bloomington, Ill.		
5.5	6x8x8			3,200				5.00	1907	"	Corinth, Miss.		
5.6	6x8x8	Hewed Sawed		2,880				6.00	1907	"	" "		
							CRESOL-CA	LCIUM.					
						(See Pi	ne Index No	s. 29.1-29.4	).				
							J. M. LONG'S	LIQUID.					
6.1			"	174				0.826	1910	I.C.	Greenville, Miss.		
							UNTRE	ATED.					
7.1				110					1909	C.B.&Q.	Lines East		
7.2				24					1908	"	" "		
7.3				48					1910	"	" "		
7.4				60					1909	"	Lines West		
7.5				29					1910	"	" "		

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Ser-vice	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					PINE—(Lobl	olly)—	(C	onti	nued	).					
						CREOSO	TE	—(	STEA	MED	).				
4.1							1916	6.0	0			Good		6.4% are rail-cut checked and split.	35.00
						CREOSO	TE	—(R	UEP	ING).					
					(See	Pine Ind	ex	Nos.	36.1-	36.12	).				
5.1	Sellers	6x8	Cut	90	Gravel		1916	7.0	21.2		21.2			Worn out and split, acct. badly creeping track.	12.11
5.2	"	6x8	"	75	"		1916	6.0	8.0		8.0			Gravel ballast since 1912, 50% tie plated. Removed acct. wind-shakes, made worse by crushing.	12.11
5.3	"	6x8	"	90	Stone		1916	7.0	9.9					50% tie-plated. Removed acct. derailment.	12.11
5.4	"	6x8	"	75	Gravel		1916	6.0	0					50% tie-plated.	12.11
5.5	None			85	"	Not Heavy	1916	9.0	0.03			Good		Slightly rail-cut.	12.11
5.6	"			85	"	"	1916	9.0	0.03			"		Slightly rail-cut.	12.11
						CRESOL	—C	AL	CIU	M.					
					• (See	Pine Ind	ex	Nos.	29.1-	29.4	).				
						J. M.	LO	NG'	S LIQ	UID.					
6.1	with Economy		Cut	75	Dirt		1916	6.0	100.0	100.0			5.5		12.11
						UN	TR	EAT	ED.						
7.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	89.1						5.20
7.2	"		"	90	Gravel		1916	8.0	95.8					Tie-plates on curves.	5.20
7.3	All		"	90	"		1916	6.0	54.2						5.20
7.4	Yes		"	85-90	Cin., Gr., Bt. Cl.		1916	7.0	98.4						5.20
7.5	"		"	90	Lyons Stone		1916	6.0	78.1						5.20

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Description of Material.									Service Conditions				
Index No.	Dimensions.	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
					•		PINE—(L	oblolly)—	(*Con*	*tinued*).			
						ZINC	CHLORIDE	—(BURNE	TT).				
						(See	Pine Index N	os. 37.1-37.4	).				
8.1	6x8x8	Hewed Sawed	Seasoned	274				0.50	1909	I.C.	Fulton, Ky.		
8.2	6x8x8	Hewed Sawed	"	274				0.50	1910	"	Greenville, Miss.		
8.3	6x8x8	Hewed Sawed	"	273				0.50	1909	"	Kankakee, Ill.		
8.4	6x8x8	Hewed Sawed	"	274				0.50	1910	"	Bloomington, Ill.		
8.5				70				0.50	1909	C.B.&Q.	Lines East		
8.6				50				0.50	1910	"	" "		
8.7				43				0.50	1909	"	Lines West		
8.8				30				0.50	1910	"	" "		
				Z	INC-	CREOS	OTE—(ALL	ARDYCE)	NO S	TEAM.			
9.1			Seasoned	100					1911	St.L.& S.W.	Texarkana, Tex.		
						ZINC-	CREOSOTE	—(CARD).					
10.1				160				Zn. 0.50 Cre. 3.00	1908	C.B.&Q.	Lines East		
10.2				426				Zn. 0.50 Cre. 3.00	1909	"	" "		
10.3				472				Zn. 0.50 Cre. 3.00	1910	"	" "		
10.4				50				Zn. 0.50 Cre. 3.00	1911	"	" "		
10.5				267				Zn. 0.50 Cre. 3.00	1909	"	Lines West		
10.6				121				Zn. 0.50 Cre. 3.00	1910	"	" "		

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Index No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					PINE—(Lobl	olly)—	(*C	onti	nued	).					
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
8.1	Sellers	6x8	Cut	90	Gravel		1916	7.0	36.9		36.9			Worn-out and split acct. badly creeping track.	12.11
8.2	"	6x8	"	75	"		1916	6.0	40.1	18.2	21.9			Gravel ballast since 1912 50% tie-plated.	12.11
8.3	"	6x8	"	90	Stone		1916	7.0	19.0					50% tie-plated. Removed acct. derailment.	12.11
8.4	"	6x8	"	75	Gravel		1916	6.0	0					50% tie-plated.	12.11
8.5	Partly		"	75-85-90	Cin., Gr. Bt. Cl.		1916	7.0	2.9						5.20
8.6	All		"	90	Gravel		1916	6.0	16.0						5.20
8.7	Yes		"	85-90	Cin., Gravel		1916	7.0	4.6						5.20
8.8	"		"	90	Lyons Stone		1916	6.0	16.7						5.20
					ZINC-CR	EOSOTE	—(	ALL	ARDY	CE)	—No	Steam.			
9.1							1916	5.0	0			Good		8% rail-cut and checked	35.00
					ZINC-CREOSO	TE—(C	AR	D).							
10.1	Partly		Cut	90	Gravel		1916	8.0	78.1					Tie-plates on curves.	5.20
10.2	"		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	0.9						5.20
10.3	All		"	90	Gravel		1916	6.0	3.2						5.20
10.4	Yes		"	75	"		1916	5.0	18.0		18.0			85 lb. rail since 1913. No tie-plates under joints.	5.20
10.5	"		"	85-90	Cin., Gr., Bt. Cl.		1916	7.0	0						5.20
10.6	"		"	90	Lyons Stone		1916	6.0	45.5						5.20

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption: Lbs. Per Tie	Average Absorption: Lbs. Cu. Ft.	Date Placed	Name of R'd.	Location	Curve or Tangent	Grade Per Cent
							PINE—(L	odgepole).					
						CR	EOSOTE—(	FULL-CEL	L).				
11.1		Hewed Sawed	Seasoned	39				8.841	1905	C.B.&Q.	Elsberry, Mo.	Tang.	
				C	REOS	OTE—	(FULL-CEL	L—LOWR	Y—RU	EPING).			
12.1				58					1907	C.B.&Q.	Sheridan, Wyo.		
						CR	EOSOTE—(	LOWRY.)					
13.1	7x8x8	Hewed	Seasoned 6-9 mos	50	Mont. & Ida.	19 to Rl.	26.9	8.62	1915	N.P.	Thompson Falls, Mont.	2° Curve	0.30
13.2	7x8x8	"	"	50	"	19 to Rl.	26.9	8.62	1915	"	" "	2° Curve	0.30
13.3	7x8x8	"	"	50	"	19 to Rl.	26.9	8.62	1915	"	" "	Tang.	0.40
13.4	7x8x8	"	"	49	"	19 to Rl.	26.9	8.62	1915	"	" "	"	0.40
						CR	EOSOTE—(	RUEPING	).				
14.1		Hewed Sawed	Seasoned	25				4.92	1905	C.B.&Q.	Elsberry, Mo.	Tang.	
							UNTRE	ATED.					
15.1		Hewed Sawed	Seasoned	10					1905	C.B.&Q.	Elsberry, Mo.	Tang.	
						ZINC	CHLORIDE	—(BURNE	TT).				
16.1				1,996					1906	C.B.&Q.	Sheridan, Wyo.		
16.2		Hewed Sawed	Seasoned	63				0.309	1905	"	Ellsberry, Mo.	Tang.	

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Service Conditions—*(Continued)*.							Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					PINE—(Lod	gepole).									
					CR	EOSOTE	—(	FUL	L-CE	LL).					
11.1	Sellers		Cut				1916	11.2	7.8			82% O. K. 7.8% rail cut		2.4% doty.	5.20
					CREOSOTE	—(FULL	-CE	LL	—LO	WRY	—RU	EPING).			
12.1	Sellers		Cut	85	Ballentine Gr.		1916	9.5	1.8		1.8			Removed acct. rail-cut.	5.20
						CREOSO	TE	—(	LOW	RY).					
13.1	N.P.Std.	7x9	Cut	90	Gravel & Sand	8.270,506	1916	1.0	0			Good			25.00
13.2	Vignoles bolted to	Rail Ch	airs	90	"	8.270,506	1916	1.0	0			"			25.00
13.3	Vignoles bolted to	Rail Ch	airs	90	"	8.270,506	1916	1.0	0			"			25.00
13.4	N.P.Std.	7x9	"	90	"	8.270,506	1916	1.0	0			"			25.00
						CREOSO	TE	—(R	UEP	ING).					
14.1	Sellers		Cut				1916	11.2	8.0			72% O. K. 20% rail worn			5.20
						UN	TR	EAT	ED.						
15.1	Sellers		Cut				1916	11.2	60.0			20% O. K. 20% rail worn			5.20
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
16.1			Cut				1916	10.0	2.9			Very Good			5.20
16.2	Sellers		Cut				1916	11.2	47.6			28.6%O.K. 17.4% rail worn		6.4% doty.	5.20

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DESCRIPTION OF MATERIAL.									SERVICE CONDITIONS				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
17.1		Hewed Sawed	Seasoned	77		PINE ZINC-	—(Lodgepole)—(*Continued*). CREOSOTE—(ALLARDYCE).	Zn. 0.384 Cre. 1.652	1905	C.B.&Q.	Elsberry, Mo.	Tang.	
						CREOSOTE—(BETHELL). (See Pine, Index No. 34.1).							
18.1	7x9x8½	Hewed		50		CR	EOSOTE—(	FULL-CEL	L).				
18.2	7x9x8½			252	N.Car.	20"		17.4	1910 1887	Q.&C. A.C.L.	Birmingham, Ala. Halifax, N. C.		
19.1			Seasoned	300	La.	CREOS	OTE—(NO	STEAM). 8.0	1910	St.L.& S.W.	Texarkana, Tex.		
20.1			Unseasoned	300	La.	CRE	OSOTE—(S	TEAMED). 12.0	1910	St.L.& S.W.	Texarkana, Tex.		
22.1	6x8x8	Sawed		2,100		19 to Rl.	UNTRE	ATED.	1899	C.M.& St.P.	Rio, Wis.		

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Service Conditions—*(Continued)*.							Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Refer-erence No.
					PINE—(Lod	gepole)	—(	*Co*	*ntinu*	*ed*).					
					ZINC	CREOSO	TE	—A	LI.A	RDY	CE).				
17.1	Sellers		Cut				1916	11.2	7.8			57.1% Good 33.8% rail worn		1.3% doty.	5.20
					PINE—(Lon	gleaf).									
					CREOSOTE—	STEAMI	NG	—(B	ETH	ELL	).				
						(See Pin	e In	dex	No. 3	4.1).					
					CR	EOSOTE	—(	FUL	L-CE	LL).					
18.1	Rolled St.	7x8½x½	Cut	85	Slag		1915	5.0	0			Sound			47.00
18.2	None				Sound	Light	1916	28.0	75.0			Good		Supposedly grown in N. Carolina. Removed acct. rail-cut and decay.	49.00
					CR	EOSOTE	—(	NO	STEA	M).					
19.1							1916	6.0	0.3		0.3	Good		Seasoned 3 mos. before and 3 mos. after treatment. 3% rail-cut, split checked.	35.00
						CREOSO	TE	—(	STEA	MED	).				
20.1							1916	6.0	0.3		0.3	Good		Seasoned 4 mos. after treatment, 4.3% rail-cut, split and checked.	35.00
						UN	TR	EAT	ED.						
22.1	None		Cut	90	Gravel	Heavy	1916	17.0	89.0			Rail-cut ½-⅝"		4% more to be removed in 1916. Removed acct decay, split and wear.	6.11

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
						PINE	—(Shortlea	f)—(*Cont*	*inued*	).			
						CREOS	OTE—(NO	STEAM).					
26.1			Seasoned 4 mos.	263	Ark.			12.00	1910	St.L.& S.W.	Dodridge, Ark.		
						CR	EOSOTE—(	RUEPING	).				
27.1	7x8x8½	Hewed Sawed	Seasoned	2,494		18 to 33'	22.5	6.80	1907	Penn.	Scio, O.	Tang.	0.1 up
						CRE	OSOTE—(S	TEAMED).					
28.1				300	Ark.			12.00	1910	St.L.& S.W.	Dodridge, Ark.		
							CRESOL-CA	LCIUM.					
29.1	8x7x9	Sawed	Seasoned	104	Ala.			1.15	1910	T.C.I.&R.	Ensley, Ala.		
29.2	8x7x9	"	"	103	"			0.85	1910	"	" "		
29.3	8x7x9	"	"	98	"			0.51	1910	"	" "		
29.4	8x7x9	"	"	93				0.27	1910	"	" "		

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Service Conditions—*(Continued)*.							Results.								
Indx No.	Tie Plates Kind	Tie Plates Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Re-moved %	Cause R'm'v'l Decay %	Cause R'm'v'l Wear %	Present Condition	Avg. Life Yrs.	Remarks	Refer-ence No.
					PINE—(Sho	rtleaf)*	—(	*Con*	*tinue*	*d*).					
					CR	EOSOTE	—(	NO	STEA	M).					
26.1							1916	6.0	1.5			Good		Removed acct. crushed. 5.3% rail-cut, split and checked.	35.00
						CREOSO	TE	—(R	UEP	ING).					
27.1	Flat	6x9	C. & S.	100	Stone		1916	9.0	64.0		64.0	Good			20.11
						CREOSO	TE	—(	STEA	MED	).				
28.1							1916	6.0	0			Good		Seasoned 3 mos. after treatment. 16.7% rail-cut, split and checked.	35.00
						CRESOL	—C	AL	CIU	M.					
29.1	Goldie		Cut		Sand & Dirt		1915	5.5	1.0	1.0				Includes loblolly pine. Tie-plates on curves only. 88.4% decayed and partly decayed.	21.00
29.2	"		"		"		1915	5.5	16.5	16.5				Includes loblolly pine. Tie-plates on curves only. 83.5% decayed and partly decayed.	21.00
29.3	"		"		"		1915	5.5	24.5	24.5				Includes loblolly pine. Tie-plates on curves only. 74.5% decayed and partly decayed.	21.00
29.4	"		"		"		1915	5.5	32.2	32.2				Includes loblolly pine. Tie-plates on curves only. 67.8% decayed and partly decayed.	21.00

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
						PINE ZINC (See	—(Shortlea CHLORIDE Pine Index	f)—(*Cont* —(BURNE Nos. 37.1-	*inued* TT). 37.4).	).			
30.1	6x8x8		Seasoned	500		22"	1.3	0.50	1907	C.M.& St.P.	Morristown, S.D.	Tang.	0.6
30.2	6x8x8	Sawed	"	500	Texas.	18 to Rl.	1.3	0.50	1903	"	Washington, Ia.	"	0
				Z	INC-	CREOS	OTE—(ALL	ARDYCE)	NO S	TEAM.			
31.1			Seasoned	100	Texas.				1911	St.L.& S.W.	Texarkana, Tex.		
							PINE—	(Sap).					
						DIAM	OND WOOD	PRESERV	ER.				
32.1	7x9x8	Hewed		500			Gal. 0.4	Gal. 0.11	1907	G.H.& S.A.	Ft. Hancock		
						ZINC	CHLORIDE	—(BURNE	TT).				
32.2	7x9x8	"		334			1.443	0.4122	1905	G.H.& S.A.	Bay View.		
32.3	7x9x8	"		333			1.443	0.4122	1905	"	" "		
32.4	7x9x8	"		334			1.443	0.4122	1905	"	" "		
							ZINC-CREO	SOTE.					
32.5	7x8x8	"		127			Zn. 1.01 C. 17.7	Zn. 0.27 Cre. 4.49	1905	"	Galveston		
32.6	7x8x8	"		750			Zn. 1.01 C. 17.7	Zn. 0.27 Cre. 4.49	1905	"	"		
32.7	7x8x8	"		126			Zn. 1.01 C. 17.7	Zn. 0.27 Cre. 4.49	1905	"	"		

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Indx No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					PINE—(Shor	tleaf)—	(C	onti	nued	).					
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
					(See	Pine In	dex	No	s. 37	.1-37	.4).				
30.1	Malleable	6x8	Cut	85	Sand to 60% Burnt Clay Gravel	5,562,600	1916	9.0	10.0			Good		Removed acct. decay and split.	6.11
30.2	Mal. Iron	5x7½	"	85		Heavy	1916	13.0	20.0		20.0	70% Slightly rail-cut		Tie-plates since 1911. 10% badly rail-cut. 5% decayed.	6.11
					ZINC-CR	EOSOTE	—(	ALL	ARDY	CE)	—No	Steam.			
31.1							1916	5.0	1.0			Good		Removed acct. split. 8% split, checked, rail-cut.	35.00
					PINE—(Sap).										
32.1	Glendon		Cut		Slag		1916	9.5	38.6					Decaying fast.	7.10
					ZINC CHLORI	DE—(B	UR	NE	TT).						
32.2			Screw				1914	9.0	100				5.4	Seasoned 3 mos. after treatment.	7.10
32.3	Glendon						1916	11.0	99.3					Seasoned 3 mos. after treatment.	7.10
32.4	None						1916	11.0	100.0				5.7	Seasoned 3 mos. after treatment.	7.10
						ZINC-	CRE	OS	OTE.						
32.5	None						1916	11.0	51.2						7.10
32.6			Screw				1916	11.0	43.9					Creosote 8 mos. after Zinc.	7.10
32.7	Glendon		"				1916	11.0	6.3					Creosote 8 mos. after Zinc.	7.10

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
						PINE	-(Southern CREO	Yellow). SOTE.					
22.2	8x7x9	Sawed		6,000				10.00	1894	N.Y.N H.&H.	Fanhaven Tunnel		
33.2	7x9x8	"		500					1906	"	" "		
33.3	7x9x8	"		200					1907	"	" "		
						CREO	SOTE—(BE	THELL).					
34.1	7x9x8½	"	Green	1,274	Miss.	22"	44.6	12.0	1907	L.&N.	Miss.	30' Curve	0.44
34.2	6x10x8			868			Gal. 4.42	Gal. 1.326	1909	G.H.& S.A.	Bay View		
34.3	7x9x9	"		285				12.00	1906	"	Lafayette		
34.4				205					1906	"	Salix		
34.5	6x10x8			1,963		18 to 33'		1.30	1911	"	Olivier		
34.6	6x10x8			849		16 to 33'		1.30	1911	"	"		
34.7	6x10x8			295		14 to 30'		1.30	1911	"	"		
34.8	6x10x8			731		16 to 33'		1.30	1911	"	"		
34.9	7x9x9	"		205					1907	"	Salix		
						CR	EOSOTE—(	LOWRY.)					
35.1			Seasoned	99			Gal. 3.5		1915	D.&L.W.	Paterson, N. J.		
35.2	7x9x8½		"	37			Gal. 3.5		1915	"	Dover, N. J.		
						CR	EOSOTE—(	RUEPING	).				
36.1		"	Seasoned	173				4.56	1905	A.T.& S.F.	Chillicothe, Ill.		
36.2		"	"	304				4.56	1905	"	Marcelline, Mo.		
36.3		"	"	44				4.56	1905	"	Sutton, Kan.		
36.4		"	"	190				4.56	1904	"	Ponca City, Okla.		
36.5		Sawed	"	275				3.93	1904	"	Bliss, Okla.		
36.6		"	"	366				3.93	1904	"	Perry, Okla.		
36.7		Hewed	"	27				4.56	1904	"	Perry, Okla.		
36.8		Sawed	"	384				3.93	1905	"	Garnet, Kan.		

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					PINE—(Sout	hern Ye	llow	).							
							CR	EOS	OTE.						
33.1	None		Cut	100	Stone	Heavy	1916	22.0	99.6					24 ties still in track.	38.10
33.2	"		"	100	"	"	1916	10.0	0						38.10
33.3	"		"	100	"		1916	9.0	0						38.10
						CREOSO	TE	—(B	ETHE	LL).					
34.1	Goldie	7x6	Cut	70	Slag		1916	9.0	0.24	0.16	0.08	Fair		Includes shortleaf and long. Joint plate 8x6.	18.00
34.2	Clark	8½x10	Screw	80	Gravel		1916	6.8	0			Good			7.10
34.3	I. & W.		Cut		Gravel		1916	10.0	34.3						7.10
34.4							1916	10.0	4.8						7.10
34.5	Clark		Screw	90	"		1916	5.0	0					9 ties slightly decayed.	7.10
34.6	"	8½x10	"	90	"		1916	5.0	0					7 ties slightly decayed.	7.10
34.7	"	8½x10	"	90	"		1916	5.0	0					4 ties slightly decayed.	7.10
34.8	"	8½x10	"	90	"		1916	5.0	0.55					2 ties slightly decayed.	7.10
34.9	Yes		Cut		"		1916	9.0	4.8						7.10
						CREOSO	TE	—(	LOW	RY).					
35.1	Hook Shoulder		S. & B.	101	Stone		1916	1.0	0						44.10
35.2	"		"	101	"		1916	1.0	0						44.10
						CREOSO	TE	—(R	UEP	ING).					
36.1	Yes	6x8	Cut	85	Gravel	10,000,000	1916	11.0	4.0					Loblolly pine predominates	45.10
36.2	"	6x8	"	85	"	10,000,000	1916	11.0	38.8	2.6	5.9			Loblolly pine predominates 30.3% removed for switch, etc.	45.10
36.3	"	6x8	"	85	Slag	6,500,000	1916	11.0	9.1		9.1			Loblolly pine predominates	45.10
36.4	"	7½x9	"	85	Rock	2,500,000	1916	12.0	4.2		4.2			" " "	45.10
36.5	"	7½x9	"	90	"	2,500,000	1916	12.0	4.0		4.0			" " "	45.10
36.6	"	7½x9	"	90	"	2,500,000	1916	12.0	0					" " "	45.10
36.7	"	7½x9	"	90	"	2,500,000	1916	12.0	0					" " "	45.10
36.8	"	7½x9	"	90	"	4,800,000	1916	11.0	10.4	10.4				" " "	45.10

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
						PINE	-(Southern	Yellow)	—(*C*	*ontinued*	).		
36.9		Sawed	Seasoned	572				3.93	1905	A.T.& S.F.	Argonia, Kan.		
36.10		"	"	54,621				5.00	1910	"	Hutch. Cut-Off		
36.11			"	9,436				5.00	1910	"	" "		
36.12	6x8x8	Hewed	"	24,238				less than 5.00	1906	"	Ottowa Cut-Off		
						ZINC	CHLORIDE	—(BURNE	TT).				
37.1		Hewed	Seasoned	9,251				0.58	1905	A.T.& S.F.	Newton, Kan.		
37.2		"	"	6,357				0.58	1904	"	" "		
37.3		Sawed	"	2,517				0.52	1904	"	" "		
37.4		"	"	40				0.52	1905	"	" "		
37.5	6x8x8	"	"	496	Texas	19 to Rl.	1.50	0.50	1906	C.M.& St.P.	Okaton, S. D.	53.8% Cv.	
							ZINC-CREO	SOTE.					
37.6				1,095					1895	G.H.& S.A.	Watkins, C. O.		
37.7	7x9x9	Hewed		433			Zn. 1.01 C. 17.7		1907	"	Salix		
37.8	7x9x9	"		476			Zn. 1.01 C. 17.7		1906	"	Lafayette		
						ZINC-	TANNIN—(	WELLHO	USE).				
38.1		"	Seasoned	25					1897	N.S.	Norfolk Div.	2° Curve	
38.2		Sawed	"	100					1897	"	" "	Tang.	
38.3		Hewed	"	100					1897	"	" "	"	

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SERVICE TESTS—(Continued).

Index No.	SERVICE CONDITIONS—(Continued). Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	RESULTS. Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					PINE—(Southern Yellow)—(Continued).										
36.9	Yes	7½x9	Cut	90	Rock	5,130,000	1916	11.0	11.2	0.7	10.5			Loblolly pine predominates	45.10
36.10	"	7½x9	Screw	90	"	4,900,000	1916	6.0	0.14		0.01			" " " 1.3% burned.	45.10
36.11	"	7½x9	"	90	"	4,900,000	1916	6.0	0					Loblolly pine predominates	45.10
36.12	"	6x8 7½x9	Cut	85	"	14,327,700	1916	10.0	0.03					" " " 90 lb. rail laid 1914 removed acct. burned.	45.10
					ZINC CHLORIDE—(BURNETTE).										
37.1	Yes	7½x9	Cut	85	Rock	15,000,000	1916	11.0	39.1	32.6				6⅛% removed for experimental purposes. Mostly loblolly pine.	45.10
37.2	"	7½x9	"	85	"	15,000,000	1916	12.0	39.0	39.0				Mostly loblolly pine.	45.10
37.3	"	7½x9	"	85	"	15,000,000	1916	12.0	55.7	55.7				Mostly loblolly pine.	45.10
37.4	"	7½x9	"	85	"	15,000,000	1916	11.0	40.0	40.0				Mostly loblolly pine.	45.10
37.5	None		"	60	Gravel	Medium	1916	10.0	0	0		94.8% Good			6.11
					ZINC-CRESOTE.										
37.6	None				Earth		1916	21.0	100.0				15.6		7.10
37.7	C.S. No. 37		Cut		Gravel		1916	9.0	83.2						7.10
37.8	I.&W.		"		"		1916	10.0	25.9						7.10 7.10

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Cross-Tie Records—Service Tests—*(Continued)*.

DESCRIPTION OF MATERIAL.									SERVICE CONDITIONS				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
						PINE	—(Western	Yellow).					
						CR	EOSOTE—(	LOWRY.)					
39.1	7x8x8	94% Sawed	Seasoned 6-9 mos.	50	Mont. & Ida.	19 to 33	22.60	7.26	1915	N.P.	Thompson Falls, Mont.	2° Curve	0.3
39.2	7x8x8	98% Sawed	Seasoned 6-9 mos.	52	Mont. & Ida.	19 to 33	22.60	7.26	1915	"	" "	2° Curve	0.30
39.3	7x8x8	98% Sawed	Seasoned 6-9 mos.	84	Mont. & Ida.	19 to 33	22.60	7.26	1915	"	" "	Tang.	0.40
39.4	7x8x8	96% Sawed	Seasoned 6-9 mos.	66	Mont. & Ida.	19 to 33	22.60	7.26	1915	"	" "	1° Curve	0.36
39.5	7x8x8	97% Sawed	Seasoned 6-9 mos.	157	Mont. & Ida.	19 to 33	22.60	7.26	1915	"	" "	1° Curve	0.36
								UNTRE	ATED.				
						(See Ta	marack Index	Nos. 6.5-6.7	).				
40.1		Triang. Sawed		1,996					1911	G.N.	Butte Div.	70% Tang.	
						ZINC	CHLORIDE	—(BURNE	TT).				
				(See	Spruce	Index	No. 5.1; Ta	marack Inde	x Nos.	7.6 and	7.8).		
41.1				6,354				0.35-0.40	1900-1	C.B.&Q.	Sidney, Neb.		
41.2			Seasoned	3,157				0.35-0.40	1906	"	Casper Div.		
41.3	Triang.	Sawed		1,963				0.50	1911	G.N.	Butte Div.	70% Tang.	
41.4	Square	"		1,327				0.50	1911	"	" "	70% Tang.	
41.5		Hewed		3,328				0.50	1911	"	" "	70% Tang.	
41.6	Triang.	Sawed		1,912				0.75	1911	"	" "	70% Tang.	
41.7	Square	"		1,367				0.75	1911	"	" "	70% Tang.	
41.8	8x12x8			2,562				0.75	1907	"	Hobson, Mont.	40% Tang.	
41.9	Triang.	"	"	2,601	Mont.	16 to 30'		0.50	1902	"	Conrad, Mont.	Tang.	0.50-0.60

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					PINE—(Wes	tern Yel	low	).							
						CREOSO	TE	—(	LOW	RY).					
39.1	N.P.Std.	7x9	Cut	90	Sand and Gr.	8,270,506	1916	1.0	0			Good			25.00
39.2	Vignoles bolted to	Rail Ch	airs	90	"	8,270,506	1916	1.0	0			"			25.00
39.3	N.P.Std.	7x9	Cut	90	"	8,270,506	1916	1.0	0			"			25.00
39.4	"	7x9	"	90	"	8,270,506	1916	1.0	0			"			25.00
39.5	Vignoles bolted to	Rail Ch	airs	90	"	8,270,506	1916	1.0	0			"			25.00
						UN	TR	EAT	ED.						
					(S	ee Tamar	ack	Ind	ex No	s. 6.	5-6.7	).			
40.1	Goldie	6x8½	Cut	90	Gravel		1916	5.3	3.0			Fair		Many ties checked and soft, 6½x8½ plates at joints.	40.10
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
				(See	Spruce Index No.	5.1; Tam	ara	ck I	ndex	Nos.	7.6	and 7.8).			
41.1	Partly		"	75	Peatz Gravel		1916	16.0	8.0	8.0		Good		Plates on curves.	5.20
41.2	None		"	65	Gravel		1916	10.0	0			"		Ties cut from dead timber show some decay, others good.	5.20
41.3	Goldie	6x8½	"	90	"		1916	5.3	0			"		6½x8½ plates at joints.	40.10
41.4	"	6x8½	"	90	"		1916	5.3	0			"		6½x8½ " " "	40.10
41.5	"	6x8½	"	90	"		1916	5.3	0			"		6½x8½ " " "	40.10
41.6	"	6x8½	"	90	"		1916	5.3	0			"		6½x8½ " " "	40.10
41.7	"	6x8½	"	90	"		1916	5.3	0					6½x8½ " " "	40.10
41.8	Glendon		"	85	"	2,146,500	1916	9.0	1.5	1.5				Contains Douglas fir, pine and spruce.	40.10
41.9	None		"	68	"	2,150,434	1916	14.0	86.0			Fair		Contains Douglas fir, pine and spruce, 6½x8½ plates at joints.	40.10

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
						PINE	—(Western	Yellow)	—(*Co*	*ntinued*	).		
						ZINC	CHLORIDE	—(BURNE	TT).				
41.10	Triang.	Sawed	Seasoned	2,916	Mont.	18 to 33′			1908	G.N.	Morovia, Ida.	80% Curve	0.50
41.11		Slabbed	"	1,066					1911	"	Butte Div.	70% Tang.	
						ZINC C	HLORIDE A	ND CRUD	E OIL.				
42.1	7x9x8	Sawed	Green	140	N. Cal.	21"	Zn. 1.0 Oil 16.25	Zn. 0.28 Oil 4.75	1906	S.P.	W. Oakland	Tang.	None
						PINE	—(Yellow	).					
							UNTRE	ATED.					
						(See	Oak Index	Nos. 35.6-	35.7).				
43.1	7x8x8⅛	"	Seasoned	32,256	South	21"			1909	P.S.&N.	New York	43% Curve	0.15
							PINUS—(	Excelsea	).				
							POWELLI	ZED.					
1.1				116					1911	N.W.	India, Ranipur Station		
1.2				108					1911	O.&R.	India		
1.3				108					1911	"	"		
							PINUS—(	Longifolia	).				
							POWELLI	ZED.					
1.1				107					1911	N.W.	India, Ranipur Station		

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Index No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					PINE—(	Western	Yel	low	).						
					ZINC	CHLORI	DE	—(	BURN	ETT	).				
41.10	Goldie	6x8½	Cut	90	Gravel	6,052,224 000	1916	13.0	96.7			Fair		Contains Douglas fir, pine and spruce, 6½x8½ plates at joints.	40.10
41.11	"	6x8½	"	90	"		1916	5.3	20.0	20.0		Very Poor		Contains Douglas fir, pine and spruce, 6½x8½ plates at joints.	40.10
					ZINC	CHLORI	DE	AN	D CR	UDE	OIL.				
42.1	Yes	8x9	Cut	75-90	Rock	Very Heavy	1916	10.0	1.4					Removed acct. broken under rail and decay.	32.11
					PINE—(Yell	ow).									
						UN	TR	EAT	ED.						
					(See Oak Index	Nos. 35.6-	35.7	).							
43.1	Wal-haupter	6x8½	Cut	85	Gravel & Slag	4,000,000	1916	7.0	20.0	20.0		Good			1.761
					PINUS—(Ex	celsea).									
						PO	WE	LLI	ZED.						
1.1							1914	3.0				Quite Good		Considerably better than P. Longifolia.	46.00
1.2							1915	4.0	0			Quite Fair		3% badly cracked.	46.00
1.3							1915	4.0	1.86			Good		Few cracked.	46.00
					PINUS—(	Longifo	lia	).							
						PO	WE	LLI	ZED.						
1.1							1914	3.0				Good		No ant attack.	46.00

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
						PINU	S—(Longif	olia)—(*C*	*ontin*	*ued*).			
							POWELLI	ZED.					
1.2				152					1911	O.&R.	India		
1.3				152					1911	"	"		
							POPLAR.						
						CR	EOSOTE—(	FULL-CEL	L).				
1.1				30					1910	C.B.&Q.	Hanover, Ill.		
1.2				20					1910	"	Blanding, Ill.		
1.3				30					1910	"	Barr, Colo.		
							UNTRE	ATED.					
2.1				55					1909	C.B.&Q.	Lines East		
2.2				25					1910	"	" "		
2.3				30					1909	"	Lines West		
2.4				15					1910	"	" "		
						ZINC	CHLORIDE	—(BURNE	TT).				
3.1				50				0.50	1910	C.B.&Q.	Lines East		
3.2				30				0.50	1910	"	Barr, Colo.		
						ZINC-	CREOSOTE	—(CARD).					
4.1				366				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
4.2				24				Zn. 0.50 Cre. 3.00	1910	"	" "		
4.3				208				Zn. 0.50 Cre. 3.00	1909	"	Lines West		
4.4				46				Zn. 0.50 Cre. 3.00	1910	"	" "		

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Index No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					PINUS—(Longifolia)—(*Continued*).										
					POWELLIZED.										
1.2							1915	4.0	2.60			Good		Some crocked and cut from heart.	46.00
1.3							1915	4.0	0					7.2% badly split. 2.6% warped, ugly looking ties but serviceable.	46.00
					POPLAR.										
					CREOSOTE—(FULL-CELL).										
1.1	All		Cut	90	Sheridan Gravel		1916	6.0	0						5.20
1.2	Yes		"	90	"		1916	6.0	0						5.20
1.3	"		"	90	Lyons Stone		1916	6.0	0					Seasoned 1 year after treatment.	5.20
					UNTREATED.										
2.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	90.9						5.20
2.2	All		"	90	Gravel		1916	6.0	68.0						5.20
2.3	Yes		"	85-90	Cin., Gr., Bt. Cl.		1916	7.0	96.7						5.20
2.4	"		"		Lyons Stone		1916	6.0	80.0						5.20
					ZINC CHLORIDE—(BURNETTIZED).										
3.1	All		Cut	90	Sheridan Gravel		1916	6.0	4.0						5.20
3.2	Yes		"	90	Lyons Stone		1916	6.0	0					Seasoned 1 year after treatment.	5.20
					ZINC-CREOSOTE—(CARD).										
4.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	7.1						5.20
4.2	All		"	90	Gravel		1916	6.0	0						5.20
4.3	Yes		"	85-90	Cin., Gr., Bt. Cl.		1916	7.0	5.8						5.20
4.4	"		"	90	Lyons Stone		1916	6.0	0						5.20

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
1.1	6x8x8	Hewed	Seasoned	15	Ind.	CR 20"	SASS EOSOTE—(9.4	AFRAS. LOWRY.) 8.10	1914	C.I.&L.	Lafayette, Ind.	Tang.	0.5
1.1				525	West. U. S.	. C	SPRUCE— REOSOTE	(Eastern —(BOILI 12.00	and NG). 1911	Western N.P.	). Seattle, Wash.		
2.1				310	West. U. S.	CR	EOSOTE—(	RUEPING 12.00	). 1911	N.P.	Seattle, Wash.		
3.1				57	West. U. S.	CRE	OSOTE AND	CRUDE O 12.00	IL. 1911	N.P.	Seattle, Wash.		
4.1	6x8x8		Seasoned 6-8 mos.	25	East. U. S.	MERC 18 to Rl.	URIC CHLO	RIDE—(K	YAN). 1911	C.M.& St.P.	Hartford, Wis.	Tang.	0
						(See	UNTRE Tamarack Ind	ATED. ex Nos. 6.5	-6.7).				

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Cross-Tie Records—Service Tests—*(Continued)*.

Service Conditions—*(Continued)*.							Results.								
Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					SASSAFRAS	—(*Cont*	*inu*	*ed*).							
						CREOSO	TE	—(	LOW	RY).					
1.1	Economy	7	Cut	90	Gravel	5,297,567	1916	2.0	0			Excellent		Treated July, 1913; set June, 1914.	51.00
					SPRUCE—(	Eastern	and	We	stern	).					
						CREOSO	TE	—(	BOIL	ING	).				
1.1							1915	4.0	0						19.00
						CREOSO	TE	—(R	UEP	ING).					
2.1							1915	4.0	0						19.00
					CR	EOSOTE	AN	D C	RUD	E,OI	L.				
3.1							1915	4.0	0					Crude Oil, 80% Creosote, 20%.	19.00
					MER	CURIC	CH	LO	RIDE	—(K	YAN	).			
4.1	50% none 50% Economy	7½x9	50% C. 50% S.	90	Gravel	Heavy	1916	5.0	0			100% Good			27.00

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Cross-Tie Records—Service Tests—*(Continued).*

DESCRIPTION OF MATERIAL.									SERVICE CONDITIONS				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
							SPRUCE	—(*Contin*	*ued*).				
						ZINC	CHLORIDE	—(BURNE	TT).				
				(Se	e Pine	Index	Nos. 41.8-41.	10 and Tam	arack,	7:6 and	7.8).		
5.1		Triang.		2,823	West. U. S.			0.50	1904	G.N.	Columbia Falls, Mont.	Tang.	
							SYCA	MORE.					
						CR	EOSOTE—(	FULL-CEL	L).				
1.1				75					1910	C.B.&Q.	Lines East		
1.2				15					1910	"	Barr, Colo.		
							UNTRE	ATED.					
2.1				65					1909	C.B.&Q.	Lines East		
2.2				25					1910	"	" "		
2.3				35					1909	"	Lines West		
2.4				15					1910	"	" "		
						ZINC	CHLORIDE	—(BURNE	TT).				
3.1				75				0.50	1910	C.B.&Q.	Lines East		
3.2				15				0.50	1910	"	Barr, Colo.		
						ZINC-	CREOSOTE	—(CARD).					
4.1				173				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
4.2				224				Zn. 0.50 Cre. 3.00	1910	"	" "		
4.3				91				Zn. 0.50 Cre. 3.00	1909	"	Lines West		
4.4				30				Zn. 0.50 Cre. 3.00	1910	"	" "		

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Indx No.	Service Conditions—*(Continued)*. Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. In-spected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					SPRUCE—(	*Continu*	*ed*	).							
					ZINC	CHLORI	DE	—(	BURN	ETT		).			
					(See Pine Index	Nos. 41.8	-41.	10	and T	amar	ack, 7	.6 and 7.8).			
5.1	Goldie & G. N.		9/16x5½ ⅝x6	90	Gravel		1916	12.0	84.4					Includes fir, pine, tamarack. Removed acc. decayed, split and broken.	40.10
					SYCAMORE.										
					CR	EOSOTE	—(	FUL	L-CE	LL).					
1.1	All		Cut	90	Sheridan Gravel		1916	6.0	1.3						5.20
1.2	Yes		"	90	Lyons Stone		1916	6.0	0					Seasoned 1 year after treatment.	5.20
						UN	TR	EAT	ED.						
2.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	84.6						5.20
2.2	All		"	90	Gravel		1915	5.0	100.0				3.2		5.20
2.3	Yes		"	85-90	Cin., Gr., Bt. Cl.		1916	7.0	97.2						5.20
2.4	"		"	90	Lyons Stone		1915	5.0	100.0				3.9		5.20
					ZINC	CHLORI	DE	—(	BURN	ETT		).			
3.1	All		Cut	90	Sheridan Gravel		1916	6.0	2.7						5.20
3.2	"		"	90	Lyons Stone		1916	6.0	6.7					Seasoned 1 year after treatment.	5.20
					ZINC-CREOSO	TE—(C	AR	D).							
4.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	9.8						5.20
4.2	All		"	90	Gravel		1916	6.0	0.9						5.20
4.3	"		"	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	6.6						5.20
4.4	"		"	90	Lyons Stone		1916	6.0	0						5.20

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption: Lbs. Per Tie	Average Absorption: Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							TAMARA	CK.					
						CR	EOSOTE—(	BOILING)					
1.1				486				12.00	1911	N.P.	Seattle, Wash.		
						CR	EOSOTE—(	FULL-CEL	L).				
2.1				85				8.05	1909	C.B.&Q.	Lines East		
2.2				20				8.05	1910	"	" "		
2.3				14				8.05	1911	"	" "		
2.4				46				8.05	1909	"	Lines West		
2.5				60					1910	"	" "		
3.1			Various Seasoning	19		19 to 33'	15.5		1907	C.&N.W.	Janesville, Wis.		
						CR	EOSOTE—(	RUEPING	).				
4.1				504				12.00	1911	N.P.	Seattle, Wash.		
						CRE	OSOTE AND	CRUDE O	IL.				
5.1				204				12.00	1911	N.P.	Seattle, Wash.		
							UNTRE	ATED.					
6.1				85					1909	C.B.&Q.	Lines East		
6.2				10					1910	"	" "		
6.3				47					1909	"	Lines West		
6.4				30					1910	"	" "		
6.5	Sawed 7x9x8 Hewed 7x7x8	54% Sawed 46% Hewed	Unseasoned	2,894	West. Mont.	18 to Rl.			1908	G.N.	Newport, Wash.	1° 15' Cv. 80% Tang.	0.40

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Index No.	Service Conditions—(Continued). Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Results. Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					TAMARACK	—(Continued).									
						CREOSOTE—(BOILING).									
1.1							1915	4.0	0						19.00
						CREOSOTE—(FULL-CELL).									
2.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	0						5.20
2.2	All		"	90	Gravel		1916	6.0	0						5.20
2.3	Partly		"	75	"		1916	5.0	0					No tie-plates under joints.	5.20
2.4	Yes		"	85-90	Cin., Gr., Bt. Cl.		1916	7.0	0						5.20
2.5	"		"	90	Lyons Stone		1916	6.0	0						5.20
						CREOSOTE—(OPEN-TANK).									
3.1	Walhaupter			90	Gravel		1916	8.5	0			100% Good			26.00
						CREOSOTE—(RUEPING).									
4.1							1915	4.0	0						19.00
						CREOSOTE AND CRUDE OIL.									
5.1							1915	4.0	0					80% Crude Oil 20% Creosote.	19.00
						UNTREATED.									
6.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1915	6.0	100.0				4.7	All out 6 years.	5.20
6.2	All		"	90	Gravel		1916	6.0	60.0						5.20
6.3	"		"	85-90	Cin., Gr., Bt. Cl.		1916	7.0	100.0				4.9	All out 7 years.	5.20
6.4	"		"	90	Lyons Stone		1916	6.0	66.7						5.20
6.5	G.N. No. 58	6x8½	½x6	90	Lyons Stone	6,052,224	1916	8.0	82.2			Fair Gravel		Includes pine, spruce 112,093,- 1916 8.0 82.2 and fir. Removed acct. decay and split.	40.10

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							TAMARACK—(*Continued*).						
6.6	7x8x8			2,989					1908	"	Judith, Gap, Mont.	60% Tang. 40% Curve	
6.7	7x9x8	Sawed	Seasoned	2,916	West. Mont.	18 to Rl.			1908	"	Rimrock, Mont.	3° 30′ Cv. 10% Tang.	0.50
6.8	7x8x8			1,575					1904	"	Mohall, N. D.	Tang.	
6.9	6x7x8	Hewed	"	2,824	North. Minn.	16 to 30 ft. Rl.			1904	"	"	1° Curve 98% Tang.	0.3
6.10		"	Peeled and seasoned 23 mos	25		19 to 33′			1907	C.&N.W.	Janesville, Wis.		
6.11			Peeled and seasoned 35 mos.	20		19 to 33′			1907	"	" "		
6.12			Unpeeled and seasoned 11 m.	62		19 to 33′			1907	"	" "		
						ZINC	CHLORIDE—(BURNETT).						
7.1		Triang.		1,320				0.45-0.50	1904	C.B.&Q.	Lines West		
7.2				85				0.50	1909	"	Lines East		
7.3				21				0.50	1910	"	" "		
7.4				45				0.50	1909	"	Lines West		
7.5				61				0.50	1910	"	" "		
7.6	7x9x8	Sawed	Seasoned	2,848	West. Mont.	16 to 30 ft. Rl.		0.50	1903	G.N.	Granville, N.D.	Tang.	0.40
7.7				2,580				0.50	1903	"	Glenburn, N. D.	"	
7.8				2,708				0.50	1904	"	White Fish, Mont.	"	
7.9			Peeled and unpeeled seasoned 3-7 m.	125		19 to 33′		0.510	1907	C.&N.W.	Janesville, Wis.		
7.10			Peeled and seasoned 10 mos.	125		19 to 33′		0.508	1907	"	" "		

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					TAMARACK	—(*Con*	*tin*	*ued*	).						
6.6	No. 204 Goldie		9/16x 5½	85	Gravel	2,146,500	1916	8.0	35.7	35.7				No. 204 tie plates on tangent Goldie on curves. Includes pine, spruce and fir.	40.10
6.7	G.N. No. 58	6x8½	⅞x6	90	"	2,146,500	1916	8.0	61.5	61.5		Fair		Includes pine, spruce and fir.	40.10
6.8	None		9/16x 5½	68	"	315,650	1916	12.0	59.2	59.2					40.10
6.9	"		Cut	68	Gr., Cin. Patches	315,650	1916	12.0	52.7	52.7		"		Includes cedar.	40.10
6.10	"		"	90	Gravel	Light	1916	8.5	72.0					28% decayed and partly decayed.	26.00
6.11	"		"	90	"	"	1916	8.5	95.0						5% Decayed.	26.00
6.12	"		"	90	"	"	1916	8.5	100.0					6.5	All out 8.5 years.	26.00
					ZINC	CHLORI	DE	—(	BUR	NET	TE).				
					(See Pine Index	Nos. 41.8	-41	10 a	nd Sp	ruce	Index	No. 5.1).			
7.1				85	Rock		1915	11.3	72.0			"			5.20
7.2	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	1.2						5.20
7.3	All		"	90	Gravel		1916	6.0	0						5.20
7.4	Yes		"	85-90	Cin., Gr., Bt. Cl.		1916	7.0	0						5.20
7.5	"		"	90	Lyons Stone		1916	6.0	1.6						5.20
7.6	None		9/16x 5½	60	Cin.,Gravel	315,650	1916	13.0	17.0	17.0		"		Includes pine, spruce and fir.	40.10
7.7	"		9/16x 5½	60	"	315,650	1916	13.0	9.8	9.8					40.10
7.8	Goldie G. N. 58		9/16x 5½	90	Gravel		1916	12.0	76.7					Includes pine, spruce and fir. Removed acct. decayed, split and broken.	40.10
7.9	Sellers		Screw	90	"	Light	1916	8.5	0			99.2% Good		0.8% partly decayed.	26.00
7.10	"		Cut	90	"	"	1916	8.5	0			100% Good.			26.00

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Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption		Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							Lbs. Per Tie	Lbs. Cu. Ft.					
							TAMARACK—(*Continued*).						
7.11			Peeled and unpeeled seasoned 3-7 mos.			19 to 33'		0.508	1907	C.&N.W.	Janesville, Wis.		
7.12			Peeled, seasoned 10 mos.	13		19 to 33'		0.308	1907	"	" "		
						ZINC-CREOSOTE—(CARD).							
						(See Hemlock, Ind ex No. 5.5).							
8.1				513				Zn. 0.50 Cre. 3.00	1909	C.B.&Q.	Lines East		
8.2				298				Zn. 0.50 Cre. 3.00	1910	"	" "		
8.3				39				Zn. 0.50 Cre. 3.00	1911	"	" "		
8.4				284				Zn. 0.50 Cre. 3.00	1909	"	Lines West		
8.5				211				Zn. 0.50 Cre. 3.00	1910	"	" "		
						ZINC AND CRUDE OIL.							
9.1				2					1911	C.B.&Q.	Baders, Ill.		
						ZINC-TANNIN—(WELLHOUSE).							
10.1				544,000				Z. C .443 Gel. .072 Tan. .086	1906-07	C.&N.W.	Various		
10.2	6x8x8		Seasoned	46,800		22"		Z. C. .443 Gel. .072 Tan. .086	1905	"	Maribel, Wis.	Tang.	
10.3	6x8x8			76,000		22"		Z. C. .443 Gel. .072 Tan. .086	1905	"	Laona, Wis.	2% Curve 98% Tang.	

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	In-spec-ted	Time Ser-vice	Re-moved %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Condition Present	Yrs. Avg.		No. Refer-
					SERVICE CONDITIONS—(*Continued*).			RESULTS.							
					TAMARACK	—(*Con*	*tin*	*ued*	).						
7.11	Wal-haupter		Cut	90	Gravel	Light	1916	8.5	0			97.6% Good		2.4% partly decayed.	26.00
7.12	"		"	90	"	"	1916	8.5	0			92.3% Good		7.7% partly decayed.	26.00
					ZINC-CREOSO	TE—(C	AR	D).							
					(See Hem	lock,	Ind	ex No.	5.5).						
8.1	Partly		Cut	75-85-90	Cin., Gr., Bt. Cl.		1916	7.0	0.6						5.20
8.2	All		"	90	Gravel		1916	6.0	0						5.20
8.3	Yes		"	75	"		1916	5.0	0					No tie-plates under joints.	5.20
8.4	"		"	85-90	Cin., Gr., Bt. Cl.		1916	7.0	0						5.20
8.5	"		"	90	Lyons Stone		1916	6.0	1.0						5.20
						ZINC A	ND	CR	UDE	OIL.					
9.1	Yes		Cut	75	Gravel		1916	5.0	0					No tie-plates under joints.	5.20
					ZINC-TANNIN	—(WEL	LH	OU	SE).						
10.1							1916	9.0	12.0					Includes hemlock.	48.00
10.2	None		Cut	72	Gravel		1916	11.0	16.1			Fair		Includes hemlock.	48.00
10.3	Wal-haupter		"	74	"		1916	11.0	1.6					Tie-plates on curves only. Includes hemlock.	48.00

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Cross-Tie Records—Service Tests—*(Continued)*.

Description of Material.									Service Conditions				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							TAMARACK—*(Continued)*.						
10.4	6x8x8			17,622				Z. C. .443 Gel. .072 Tan. .086	1904	C.&N.W.	Peninsula Div., Wis. & Mich.		
10.5		Hewed	Peeled and seasoned 11 mos.	125				0.423	1907	"	Janesville, Wis.		
10.6		"	Unpeeled seasoned 11 mos.	41				0.440	1907	"	" "		
10.7		"	Unpeeled seasoned 11 mos.	9				0.440	1907	"	" "		
10.8		"	Unpeeled seasoned 11 mos.	31				0.408	1907	"	" "		
10.9		"	Peeled, seasoned 11 mos.	7				0.408	1907	"	" "		
10.10		"	Peeled, seasoned 11 mos.	125				0.428	1907	"	" "		
10.11		"	Unpeeled, seasoned 11 mos.	50				0.436	1907	"	" "		
10.12		"	Peeled, seasoned 11 mos.	128				0.408	1907	"	" "		
10.13		"	Unpeeled, seasoned 11 mos.	50				0.436	1907	"	" "		
10.14		"	Peeled and unpeeled, seasoned 10 mos.	59				0.424	1907	"	" "		
10.15		"	Peeled and unpeeled, seasoned 10 mos.	58				0.376	1907	"	" "		
							TERMINALIS TEMENTOSA. POWELLIZED.						
1.1				131					1911	O.&R.	India		
1.2				187					1911	"	"		
1.3				158					1911	N.W.	India, Ranipur Station		

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Indx No.	Tie Plates: Kind	Tie Plates: Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l: Decay %	Cause R'm'v'l: Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					TAMARACK	—(*Continued*).									
10.4							1916	12.0	37.3	23.0	9.0			Includes hemlock 5% removed acct. shaky butts.	48.00
10.5	Sellers		Screw	90	Gravel	Light	1916	8.5	0			96.8% Good		3.2% partly decayed.	26.00
10.6	"		"	90	"	"	1916	8.5	0			97.6% Good		2% partly decayed. 2.4% partly split.	26.00
10.7	Creo. Wood		"	90	"	Light	1916	8.5	11.1			77.8% Good		11.1% partly decayed.	26.00
10.8	"		"	90	"	"	1916	8.5	0			93.6% Good		3.2% partly decayed. 3.2% partly split.	26.00
10.9	Sellers		Cut	90	"	"	1916	8.5	0			100% Good			26.00
10.10	"		"	90	"	"	1916	8.5	0			96.8% Good		3.2% partly decayed.	26.00
10.11	"		"	90	"	"	1916	8.5	0			100% Good			26.00
10.12	Wal-haupter		"	90	"	"	1916	8.5	0.8			97.6% Good		0.8% partly decayed. 0.8% partly split.	26.00
10.13	"		"	90	"	"	1916	8.5	0			100% Good			26.00
10.14	"		"	90	"	"	1916	8.5	0			83% Good		15.3% decayed and partly decayed. 1.7% partly split.	26.00
10.15	"		"	90	"	"	1916	8.5	1.7			94.6% Good		94.8% Good 3.5% partly decayed.	26.00
					TERMINALI	S TEM PO	EN WE	TO LLI	SA. ZED.						
1.1							1915	4.0	0					6.1% split, faults in timber.	46.00
1.2							1915	4.0	0			94.8% Good			26.00
1.3							1914	3.0	0			"		No attack by ants. 13% cracked; to be removed.	46.00

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Cross-Tie Records—Service Tests—*(Continued)*.

DESCRIPTION OF MATERIAL.									SERVICE CONDITIONS				
Index No.	Dimensions	Form	Preparation	No. of Ties In Test	Where Grown	Spacing In Track	Average Absorption Lbs. Per Tie	Average Absorption Lbs. Cu. Ft.	Date Placed	Name of R. R.	Location	Curve or Tangent	Grade Per Cent
							WALNUT	—(Black	).				
						CR	EOSOTE—(	LOWRY.)					
1.1	6x8x8	Hewed	Seasoned	4	Ind.	20"	12.4	4.6	1914	C.I.&L.	Lafayette, Ind.	Tang.	.5

SERVICE CONDITIONS—*(Continued)*.							RESULTS.								
Indx No.	Tie Plates Kind	Tie Plates Size In.	Kind of Spikes	Wt. of Rail Lbs.	Kind of Ballast	Traffic Tons Per Year	Inspected	Time Service	Removed %	Cause R'm'v'l Decay %	Cause R'm'v'l Wear %	Present Condition	Avg. Life Yrs.	Remarks	Reference No.
					WALNUT—(	Black).									
						CREOSO	TE	—(	LOW	RY).					
1.1	Economy	7	Cut	90		5,297,567	1916	2.0	0			Excellent		Treated July, 1913; set June, 1914.	51.00

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Reference And Authorities Quoted In Compiling Report.

Ref. No.	Information Obtained From	Year	Authority
1.761	Letters and reports	1916	H. S. Wilgus, Eng. M. of W., P. S. & N. Ry.
4.11	" " "	1916	F. J. Angier, Supt. of Timber Preservation, B. & O. Ry.
5.20	" " "	1916	J. H. Waterman, Supt. Timber Preservation, C. B. & Q. Ry.
6.11	" " "	1916	F. S. Pooler, Tie Agent, C. M. & St. P. Ry.
7.10	" " "	1916	E. B. Cushing, Asst. Gen. Mgr., Sunset Central Lines (G. H. & S. A.)
8.10	" " "	1916	L. C. Hartley, Chief Engineer, C. & E. I. R. R.
12.11	" " "	1916	E. H. Bowser, Supt., Timber Dept., Illinois Central Ry.
14.10	" " "	1916	D. C. Moon, Gen. Mgr., N. Y. Central Lines West.
16.10	" " "	1916	J. H. Young, Prest., Norfolk Southern Ry.
17.00	" " "	1916	Geo. L. Pollock, Purchasing Agent, C. & W. I. Ry.
18.00	" " "	1916	John B. Lindsey, Supt. Treating Plants, L. & N. Ry.
19.00	" " "	1916	Lowry Smith, Supt. Tie Treating Plants, Northern Pacific Ry.
20.11	" " "	1916	B. McKeen, Gen. Mgr., Pennsylvania System West.
21.00	Forest Service Project No. 38	1915	
22.00	" " " " 41	1915	
24.00	" " " " 44	1916	
25.00	" " " " 50	1916	
26.00	" " " " 51	1916	
27.00	" " " " 111	1916	
28.00	Letters and reports	1916	S. Murray, Chief Engineer, O. W. R. R. & N. Co.
30.20	" " "	1916	O. C. Steinmayer, Supervisor Timber Preservation, St. L. & S. F. Ry.
32.10	" " "	1916	J. Q. Barlow, Asst. Chief Engineer, W. R. Scott, Asst. Gen. Mgr., Southern Pacific Ry.
34.00	" " "	1916	W. M. Robinson, Valuation Engineer, Georgia R. R.
35.00	" " "	1916	C. D. Purdon, Chief Engineer, St. L. Southwestern Ry. Lines.

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Ref. No.	Information Obtained From	Year	Authority
36.00	Letters and reports	1916	C. F. Ford, Supervisor Tie & Timber Supply, C. R. I. & P. R. R.
38.10	" " "	1916	W. J. Backes, Eng. M. of W., N. Y., N. H. & H. Ry.
40.10	" " "	1916	J. R. W. Davis, Eng. M. of W., Great Northern Ry.
44.10	" " "	1916	C. E. Gosline, Treating Inspector, D. L. & W. Ry.
45.10	" " "	1916	Geo. E. Rex, Mgr. Treating Plants, A. T. & S. F. Ry.
46.00	" " "	1916	R. S. Pearson, Forest Economist, Forest Research Institute and College, Dehra Dun, U. P. India.
47.00	" " "	1916	Curtis Dougherty, Chief Engineer, Queen & Crescent.
48.00	" " "	1916	M. Hughitt, Jr., Vice Pres., C. & N. W. Ry.
49.00	" " "	1916	Wm. A. Fisher, Formerly Supt. Timber Preservation, Atl. C. Line.
50.00	" " "	1916	H. T. Douglas, Jr., Chief Engineer, Chicago and Alton Ry.
51.00	" " "	1916	T. G. Stull, Chief Timber Inspector, C. I. & L. Ry.

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SERVICE TESTS OF TREATED AND UNTREATED POSTS OF VARIOUS SPECIES.*

Species	Method of Treatment		Location	Years of Service at Last Inspection	Date of Last Inspection	Total No. of Posts	% Sound	% Partly Decayed — Ground Line	% Partly Decayed — Top Butts	% Decayed — Ground Line	% Decayed — Top Butts	% Removed for Decay	% Not Inspected	Remarks
Ash	Brush	Carbolineum	University Farm, Minn.	4	Nov. 1916	8	...	...	100	...	...	...	...	2 coats
"	Dip	"	" " "	4	" "	8	68.0	...	64.0	...	...	...	...	2 minute dip
"	Brush	C. T. C.	" " "	4	" "	8	...	...	100	...	...	...	...	2 coats
"	Dip	"	" " "	4	" "	8	88.0	...	80.0	...	...	...	...	2 minute dip
"	Open tank	"	" " "	4	" "	4	100	...	...	...	...	...	...	Hot bath 7 hours
"	"	"	" " "	4	" "	4	100	...	...	...	...	...	...	Hot bath 1/2 hour and cold bath 3/4 hours.
"	"	"	" " "	4	" "	4	100	...	...	...	...	...	...	Entire post treated - 1/2 hr. hot bath; 3/4 hr. cold
"	Untreated	...	" " "	4	" "	4	...	...	100	...	...	...	...	
Ash, green	Open tank	C. T. C.	Ames, Iowa	4	June, 1916	11	64.0	...	27.0	...	9.0	...	...	Butt treatment too short
"	"	"	" "	4-1/2	"	25	68.0	...	32.0	...	17.0	...	...	" " " "
"	"	"	Ogdensburg, Iowa	4-1/2	Nov. 1914	58	77.1	...	3.9	...	...	...	...	Hot and cold bath. Tops are checked [5]
Aspen	Untreated	...	Flagstaff, Arizona	1	Nov. 1912	10	100	...	...	...	...	...	...	Not green
"	"	...	" "	3	Jan. 1913	10	100	...	...	...	...	...	...	Remained posts
Balsam	Brush	Carbolineum	University Farm, Minn.	4	Nov. 1916	1	100	...	...	...	...	...	...	2 coats
"	Dip	"	" " "	4	Nov. 1916	1	100	...	...	...	...	...	...	2 minute dip
"	Dip	C. T. C.	" " "	4	" "	4	50.0	...	50.0	...	...	...	...	2 minute dip
"	Open tank	"	" " "	4	" "	2	100	...	...	...	...	...	...	Hot bath 1/2 hr., cold 3/4 hr.
"	"	"	" " "	4	" "	4	100	...	...	...	...	...	...	Started in hot C.T.C.- left to cool over night.
Basswood	"	"	Ames, Iowa	6	June 1916	15	60.0	...	27.0	...	33.0	...	...	Butt treatment too short
"	"	"	Embers Heights, Minn.	7-1/2	July 1916	210	84.8	7.9	3.81	1.4	1.4	0.6	...	Entire post treated - split posts
"	"	"	" "	7-1/2	"	22	27.3	27.3	...	50.0	...	22.8	...	
"	"	"	" "	7-1/2	"	22	54.6	4.6	...	4.6	30.0	16.0	...	Entire post treated - cold oil only - split posts
"	"	U.S.F.S.	" "	7-1/2	"	22	68.1	4.6	4.6	4.6	4.6	13.5	...	Entire post treated
"	"	C. T. C.	" "	7-1/2	"	15	80.0	20.0	...	46.7	6.7	13.3	...	" " "
Bay, Sweet	"	C. T. C.	Calhoun, Louisiana	6 - 7	Jan' 1916	146	98.5	...	1.5	...	17.9	0.7	...	Entire post treated
Beech	"	"	College Park, Md.	6	Nov. 1914	50	94.0	...	2.0	...	...	...	...	Entire post treated - double tank
Beech	"	"	" "	6	" "	5	80.0	...	20.0	...	...	...	...	Single tank
"	"	"	" "	6	" "	10	100	...	...	...	...	...	...	Hot bath crude petroleum - Cold bath C. T. C.
"	"	U. S. F. S	" "	6	" "	5	100	...	...	...	...	...	...	
"	Untreated	...	" "	6	" "	5	60.0	...	...	...	60.0	...	...	
Birch	Dip	Carbolineum	University Farm, Minn.	4	Nov. 1916	1	100	...	...	...	...	...	...	2 minute dip
"	"	C. T. C.	" " "	4	" "	1	100	...	...	...	...	...	...	2 " "
"	Open tank	"	" " "	4	" "	1	100	...	...	...	...	...	...	Hot C. T. C. 2 hours
"	Untreated	...	" " "	4	" "	2	...	...	100	...	...	...	...	
Birch, River	Open tank	C. T. C.	College Park, Md.	6	Nov. 1914	30	94.7	...	5.3	...	...	...	...	Entire post treated - double tank
"	"	"	" "	6	" "	10	70.0	...	10.0	...	20.0	...	...	Hot bath crude petroleum. Cold bath C.T.C.
"	"	"	" "	6	" "	1	...	...	...	...	...	...	...	1 Irregular punctations
"	Soaking	W. O. P.	" "	6	" "	5	60.0	...	20.0	...	40.0	...	...	No cold bath
"	Untreated	...	" "	6	" "	5	40.0	...	...	...	60.0	...	...	
Birch, Yellow	Open tank	C. T. C.	Embers Heights, Minn.	7-1/2	July 1916	26	26.9	...	46.2	...	26.9	...	...	
"	"	"	" "	7-1/2	"	4	25.3	...	...	...	74.7	...	...	Entire post treated
Boxelder	"	"	Ogdensburg, Iowa	4-1/2	Nov. 1914	10	40.0	20.0	...	20.0	...	...	...	Two posts show no sign of treatment [5]
Butternut	"	"	Ames, Iowa	6	June 1916	10	20.0	80.0	...	170.0	...	...	...	
"	"	"	" "	4-1/2	"	25	44.0	...	28.0	1	8.0	...	...	Seasoned split posts
Cedar, Northern White	Brush	Carbolineum	University Farm, Minn.	4	Nov. 1916	1	80.0	...	80.0	...	...	...	...	2 coats
"	Dip	"	" " "	4	" "	10	80.0	...	80.0	...	...	...	...	1 minute dip
"	"	"	" " "	4	" "	4	75.0	...	25.0	...	...	...	...	2 minute dip
"	Brush	C. T. C.	" " "	4	" "	1	...	...	100	...	...	...	...	2 coats
"	Dip	"	" " "	4	" "	7	100	...	...	...	...	...	...	1 minute dip
"	"	"	" " "	4	" "	11	63.4	...	36.4	...	...	...	...	2 minute dip
"	"	"	" " "	4	" "	11	54.7	...	45.3	...	...	...	...	10 minute dip
"	Open tank	"	" " "	4	" "	13	...	...	...	...	...	...	...	Hot C. T. C. two hours
"	"	"	" " "	4	" "	10	100	...	...	...	...	...	...	1/2 hr. hot C. T. C., 1/2 hr. cold
"	"	"	" " "	4	" "	5	100	...	...	...	...	...	...	3/4 " " " 3/4 " "
"	"	"	" " "	4	" "	1	100	...	...	...	...	...	...	3/4 " " " 1/2 " "
Cedar, Idaho	"	"	Nat'l. Bison Range, Mont.	7	Sept. 1916	7000	100	...	...	...	...	...	...	Fire killed cedar. Single tank treated. Absorption 3/4 to 1/2 gal.
Cedar, Incense	Untreated	...	Cal. National Forest	8	Aug. 1915	63	100	...	...	...	...	...	...	Seasoned split posts
"	"	...	Plumas National Forest, California											
Cedar, Red (Juniper)	Open tank	C. T. C.	College Park, Md.	1	June 1914	16	100	...	...	...	...	...	...	Split posts, seasoned one month
"	"	"	" "	6	Nov. 1914	30	100	...	...	...	...	...	...	Entire post treated - double tank
"	"	"	" "	6	" "	5	100	...	...	...	...	...	...	Single tank
"	"	"	" "	6	" "	5	100	...	...	...	...	...	...	Hot bath crude petroleum - Cold bath C. T. C.
"	Untreated	...	" "	6	" "	5	100	...	...	...	...	...	...	
Cedar, Northern White	Open tank	C. T. C.	Ames, Iowa	6	June 1916	254	99.6	...	...	...	...	0.4	...	Removed for other cause than decay
"	"	"	" "	6	" "	238	95.8	0.9	2.9	...	...	0.9	...	" " " " " "
"	Untreated	...	" "	3	" "	8	100	...	...	...	...	...	...	

Note.— * Unless otherwise specified only the butts of posts were treated.
C. T. C. - Coal tar creosote - Unless otherwise stated in "Remarks" a hot and cold bath was employed.
W. G. P. & C. - Water gas tar & creosote - Unless otherwise stated in "Remarks" a hot bath of water gas tar and a cold bath of coal tar creosote were employed.
S. T. - Water gas tar - Unless otherwise stated in "Remarks" a hot and cold bath was employed.
Semi-liquid asphaltum

1 Includes 6 posts, both butts and tops partly decayed.
2 " 1 post, both butt and top decayed.
3 " 1 " " " " partly decayed.
4 " 1 " " " " decayed.
5 Inspected by Mr. C. B. MacDonald, Professor of Forestry, Iowa State College.

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SERVICE TESTS OF TREATED AND UNTREATED POSTS OF VARIOUS SPECIES.—*(Continued.)*

Species	Preservation	Preservative Sold as	Treatment	Location: Line	Location: State	Date Set	Date Inspected	Removed: Causes other than decay	Not Inspected	Total No. in Summary	% Sound	% Partially Decayed	% Removed for Decay	Remarks
Cedar, Incense	...	...	Untreated	S. P. R.	California	1911	1914	160	1	...	149	36.9	60.4	8.7	Heartwood sawed 4" x 4" x 30".
" S. White	Seasoned	Carbolineum, Avenarius	Brush	C.-S.	Nebraska	1910	1914	93	2	...	91	47.3	51.6	1.1	
" " "	"	Creosote, Coal Tar	"	C.-S.	Nebraska	1910	1914	95	...	...	95	7.4	90.6	2.0	
" " "	Green	" " "	Open tank	C.-S.	Nebraska	1910	1914	45	...	...	45	97.7	2.3	...	
" " "	Seasoned	" " "	"	C.-S.	Nebraska	1910	1914	137	5	...	132	100	...	...	
" " "	...	...	Untreated	C.-S.	Nebraska	1910	1914	99	2	...	97	...	94.8	5.2	
Cedar, S. White	...	Carbolineum, Avenarius	Brush- 2 coats	C.-S.	Georgia	1906	1914	54	...	...	54	...	54.8	45.2	
" " "	...	Carbolineum, S. P. P.	" 1 coat	C.-S.	Georgia	1906	1914	3	...	...	3	...	...	100	
" " "	...	" " "	" 2 coats	C.-S.	Georgia	1906	1914	21	1	...	20	...	40.0	60.0	
" " "	...	Creolin	" 2 coats	C.-S.	"	1906	1914	23	1	...	22	...	43.8	56.2	
" " "	...	Creosote, Coal Tar	" 2 coats	C.-S.	"	1906	1914	34	2	...	32	...	43.7	56.3	
" " "	...	" " "	" 3 "	C.-S.	"	1906	1914	14	4	...	10	...	40.0	60.0	
" " "	...	Imperial Wood Preserver	" 3 "	C.-S.	"	1906	1914	14	1	...	13	4.4	34.0	61.6	
" " "	...	Antiritine	" 3 "	C.-S.	"	1906	1914	24	1	...	23	...	24.1	75.9	
" " "	Green	Tar, Coal	"	C.-S.	"	1906	1914	12	1	...	11	...	9.1	90.9	
" " "	Seasoned	" "	"	C.-S.	"	1906	1914	22	1	...	22	...	24.1	75.9	
" " "	Green	...	Untreated	C.-S.	"	1906	1914	96	5	...	91	...	11.0	89.0	
" " "	Seasoned	...	"	C.-S.	"	1906	1914	100	0	...	100	...	6.0	94.0	
Cedar, W. Red	...	Carbolineum	Brush	Various	California	1907-09	1916	95	...	...	95	88.1	10.9	1.0	Set in vicinity of Los Angeles, Cal.
" " "	...	Creosote, Coal Tar	Open tank	"	"	1907-09	1916	98	...	...	98	90.8	8.2	1.0	" " " " " " "
" " "	...	" " "	"	"	"	1907-09	1916	433	...	...	418	98.9	1.1	...	" " " " " " "
" " "	...	Crude Oil	"	"	"	1907-09	1916	4	...	...	4	80.0	20.0	...	" " " " " " "
" " "	...	Zinc Chloride	"	"	"	1907-09	1916	135	...	...	101	15.8	84.1	0.0	" " " " " " "
" " "	...	Zinc Chloride & Creosote	"	"	"	1907-09	1916	69	...	...	46	44.9	55.1	...	" " " " " " "
" " "	...	...	Untreated	"	"	1907-09	1916	97	...	...	97	...	74.7	25.3	" " " " " " "
Chestnut	Seasoned	Carbolineum, Avenarius	Brush	C.-S.	Nebraska	1910	1914	98	...	...	98	80.9	19.9	0.2	
"	...	...	"	N. P. R.	New Jersey	1909	1914	10	...	...	10	...	100	...	Treated green.
"	Seasoned	...	Brush - 1 coat	C.	Va. & N.Y.	1908	1914	9	...	...	9	...	100	...	
"	"	...	"	C.	Georgia	1908	1914	4	...	...	4	...	100	...	
"	"	...	2 coats	C.	Va. & N.Y.	1908	1914	64	...	1	64	84.4	15.6	...	
"	"	...	2 coats	C.	Georgia	1908	1914	18	...	...	17	17.6	70.6	11.8	
"	"	C Avenarius, S. P. P.	1 coat	C.	New York	1914	1914	10	...	...	10	10.0	90.0	...	
"	"	" " "	2 coats	C.	Georgia	1908	1914	10	...	...	9	...	80.0	20.0	
"	"	" " "	2 coats	C.	Va. & N.Y.	1908	1914	66	...	...	66	44.4	37.6	...	
"	"	Creolin	2 coats	C.	Georgia	1908	1914	18	1	2	15	20.0	66.7	13.3	
"	"	"	2 coats	C.	Va. & N.Y.	1908	1914	66	...	...	66	...	100	...	
"	"	"	2 coats	C.	Va. & N.Y.	1908	1914	66	...	...	66	...	100	...	One pole marked for removal.
"	Seasoned	Creosote, Coal Tar	Brush	C.	Georgia	1908	1914	64	...	1	63	4.8	84.6	10.9	
"	Not seas'd	" " "	"	C.	Nebraska	1910	1914	81	...	...	81	2.5	96.9	0.6	
"	"	" " "	1 coat	C.	Georgia	1908	1914	2	...	...	2	...	100	...	
"	"	" " "	1 coats	C.	Georgia	1908	1914	111	6	4	88	12.1	84.8	27.3	
"	"	" " "	2 coats	C.	Va. & N.Y.	1908	1914	66	...	...	64	60.7	39.3	...	
"	"	" " "	2 coats	C.	Georgia	1908	1914	5	...	...	5	...	100	60.0	
"	Green	" " "	Open tank	C.	Va. & N.Y.	1908	1914	29	...	...	29	92.9	7.1	...	
"	Seasoned	" " "	"	C.	Va. & N.Y.	1908	1914	100	...	...	100	98.0	2.0	...	
"	"	" " "	"	C.	Nebraska	1910	1914	100	...	...	100	93.0	5.9	1.0	
"	"	Creosote, Wood	Brush 1 coat	C.	Va. & N.Y.	1908	1914	21	...	...	21	...	100	...	
"	"	" "	2 coats	C.	Va. & N.Y.	1908	1914	66	...	...	49	89.8	71.4	...	
"	"	Imperial Wood Preserver	"	C.	Georgia	1908	1914	11	1	1	10	...	89.7	30.3	
"	"	Spirigline	"	N. P. R.	New Jersey	1909	1914	11	...	...	11	...	100	...	Treated green.
"	Seasoned	"	2 coats	C.	Georgia	1908	1914	5	2	...	3	4.8	38.1	57.1	
"	"	Tar	1 coat	C.	Va. & N.Y.	1908	1914	66	...	...	66	...	100	...	
"	Green	Tar, Coal	"	C.	Georgia	1908	1914	8	...	...	7	...	28.6	71.4	
"	Seasoned	" "	"	C.	Georgia	1908	1914	61	...	...	60	...	88.0	12.0	
"	Green	Tar, Pine	"	C.	Georgia	1908	1914	8	...	...	8	...	25.0	75.0	
"	Seasoned	" "	"	C.	Georgia	1908	1914	8	...	...	8	...	100	...	
"	...	...	Charred	N. P. R.	New Jersey	1909	1914	6	...	...	6	...	100	...	
Chestnut	Green	...	Untreated	N.	Va. & N.Y.	1908	1914	198	...	...	198	...	100	...	
"	"	...	"	C.	Georgia	1908	1914	11	1	0	10	...	90.1	9.9	
"	Seasoned	...	"	C.	Va. & N.Y.	1908	1914	200	...	...	200	...	100	...	One pole marked for removal.
"	"	...	"	C.	Nebraska	1910	1914	171	4	...	170	...	98.8	1.2	
"	"	...	"	C.	Georgia	1908	1914	113	8	1	101	...	89.4	10.6	
"	"	...	"	N. P. R.	New Jersey	1909	1914	100	0	...	0	...	100	...	Set in sand.
"	"	...	"	C.	Georgia	1908	1914	97	8	...	89	...	98.8	3.4	Set in sandy loam.
"	"	...	"	C.	Georgia	1908	1914	2	...	...	2	...	100	...	Set in crushed stone.
Cypress	...	...	Untreated	C.-S.	Florida	1908	1914	90	2	...	88	2.6	68.2	29.2	
D. F. Douglas	Seasoned	Creosote, Coal Tar	Open tank	N. P. R.	California	1908	1914	119	...	...	119	100	...	...	
"	"	" " "	Charred	"	"	1908	1914	2	...	...	2	100	...	...	
"	...	...	Untreated	"	"	1908	1914	14	2	...	12	75.6	24.4	...	
Palmetto	...	...	"	C.-S.	Florida	1908	1914	97	3	...	94	...	...	100	Removals on account of insect attack. All poles reached with galvanized iron. Ave. life 6-8 yrs.
Pine, Longleaf	...	Creosote, Coal Tar	Open tank	N. P. Co.	Louisiana	1908	1914	111	...	...	111	100	...	...	
Pine, W. Yellow	Seasoned	Carbolineum, Avenarius	Brush	Various	California	1907-09	1914	111	...	...	111	18.2	81.8	0.0	Set in vicinity of Los Angeles, Cal.
" " "	"	" " "	"	"	"	1908	1914	66	...	...	66	4.6	91.1	84.8	" " " Fresno, Cal.
" " "	"	Carbolineum	"	"	"	1911	1914	1	...	...	1	100	...	0.0	
" " "	"	Creosote, Coal Tar	"	"	"	1907	1914	7	...	...	7	14.8	85.2	0.0	
" " "	"	" " "	"	"	"	1908	1914	67	...	...	67	7.1	10.1	97.8	
" " "	"	" " "	"	"	"	1907	1914	83	...	...	83	14.8	9.6	75.8	
" " "	"	" " "	Open tank	"	"	1907-08	1913	80	...	...	80	100	...	...	Set in vicinity of Los Angeles, Cal.
" " "	"	" " "	"	"	"	1909	1914	100	...	...	100	92.9	...	7.0	" " " Fresno, Cal.
" " "	"	" " "	"	"	"	1911	1914	88	...	...	88	96.4	3.6	...	
" " "	"	" " "	Plunge	"	"	1911	1914	1	...	...	1	100	...	...	
" " "	"	Creosote & Crude Oil	Open tank	"	"	1911	1914	1	...	...	1	75.0	25.0	...	
" " "	"	Crude Oil	"	"	"	1911	1914	13	...	...	13	92.3	7.7	...	
" " "	"	" "	"	"	"	1908	1914	8	...	...	8	75.0	12.5	12.5	
" " "	"	Zinc Chloride	"	"	"	1908	1914	10	...	...	9	77.8	11.1	11.1	
" " "	"	" "	"	"	"	1908	1914	10	...	...	10	70.0	20.0	10.0	
" " "	"	...	Untreated	"	"	1907-08	1914	100	...	...	100	11.0	89.0	0.0	Los Angeles, Cal.
" " "	"	...	"	"	"	1908	1914	100	...	...	100	11.0	89.0	0.0	Fresno, Cal. Ave. life 8.8 years.

*Contains water and ice also

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SERVICE TESTS OF TREATED AND UNTREATED POSTS OF VARIOUS SPECIES.—*(Continued.)*

Species	Method of Treatment		Location	Years of Service at Last Inspection	Date of Last Inspection	Total No. of Posts	% Sound	% Partly Decayed: Tops	% Partly Decayed: Butts	% Decayed: Tops	% Decayed: Butts	% Removed for Decay	% Not Inspected	Remarks
Chestnut	Open tank	C. T. C.	College Park, Md.	6	Nov. 1914	22	63.6	...	6.2	...	...	...	...	Entire post treated - double tank
"	"	"	"	6	"	8	100	...	...	...	...	...	...	Single tank
"	Untreated	...	"	6	"	8	50.0	...	...	...	50.0	...	...	
Cottonwood	Open tank	C. T. C.	Cambra Heights, Miss.	7-1/2	July 1914	43	93.1	2.3	...	2.3	2.3	...	...	4 of the sound posts are split - Entire post trtd.
"	"	"	"	7-1/2	"	9	88.9	...	...	11.1	...	...	...	
"	"	"	Danville, Iowa	7-1/2	Nov. 1914	9	88.9	11.1	...	...	88.9	...	...	Inspected by Mr. C.L. MacDonald. Tops are checked.
"	"	"	Fort Atkinson, Iowa	8-1/2-8-1/2	"	19	47.3	26.3	31.6	10.6	5.3	...	...	" " " " " 7 posts have both butt and top partly decayed.1 post both butt and top decayed.
Cypress	"	"	Calhoun, Louisiana	5 - 7	Jan. 1915	71	96.0	...	...	...	...	8.0	8.0	Entire post treated.
Elm, Red	"	"	Ames, Iowa	5-1/2	June 1915	14	57.0	6.4	14.2	...	14.2	...	14.2	
"	"	"	"	6	"	7	71.4	14.3	...	...	...	...	14.3	Removed for cause other than decay.
"	"	"	Lambra Heights, Miss.	7-1/2	July 1914	18	88.8	...	...	...	16.7	...	...	Entire post treated. 4 posts treated with cold oil only. Split posts.
"	"	"	"	7-1/2	"	8	100	...	...	...	...	...	...	Split posts.
Eucalyptus Globulus	Dip	"	Santa Barbara, Cal.	4	July 1909	4	...	...	...	...	100	...	...	
"	Open tank	"	"	4	"	9	44.4	11.1	11.1	11.1	...	...	...	Green unpeeled posts - Hot bath only.
"	"	"	Agua Mansa Land & Cal.	6	Nov. 1913	22	13.6	...	...	13.6	72.7	...	...	Green peeled posts - Hot bath only.
"	"	"	"	6	"	22	13.6	...	...	13.6	72.7	...	...	Seasoned unpeeled posts - Hot bath only.
"	"	"	"	6	"	16	18.8	...	...	6.3	6.3	...	...	Green unpeeled posts.
"	"	"	"	6	"	11	36.3	...	...	54.7	...	...	...	Seasoned unpeeled posts.
Eucalyptus Rostrata	"	"	Santa Barbara, Cal.	4	July 1909	104	92.3	1.0	1.9	...	3.8	...	...	
Eucalyptus Sideroxylon	"	"	"	4	"	1	100	...	...	...	...	...	...	
Fir, Alpine	"	"	Routt County, Colorado	4	Nov. 1915	4	54.7	...	...	...	...	...	36.5	Hot bath - cooling over night - fire killed - seasoned 27 years.
"	"	"	"	1	Sept. 1911	8	100	...	...	...	...	...	...	" " " " "
"	"	"	"	2	Nov. 1910	29	86.2	...	13.8	...	...	...	...	Hot bath - fire killed - seasoned 27 years.
"	"	"	"	1	Sept. 1911	7	85.7	...	...	...	...	...	14.3	" " " " "
"	"	"	"	6	Nov. 1914	6	100	...	...	...	...	...	...	Hot bath - short cooling - fire killed - seasoned 27 years.
"	"	"	"	1	Sept. 1911	8	100	...	...	...	...	...	...	" " " " "
"	"	"	"	2	Nov. 1910	29	100	...	...	...	...	...	...	Cut green - seasoned - hot bath.
"	"	"	"	1	Sept. 1911	7	100	...	...	...	...	...	...	" " " " "
"	Brush	U. S. T.	Fort Collins, Colorado	4	1914	10	90.0	...	10.0	...	...	...	...	2 coats - fire killed in 1892.
"	Open tank	"	"	4	1914	10	90.0	...	...	...	...	...	10.0	Hot bath 2 hrs. - fire killed in 1892.
"	Untreated	...	Routt County, Colorado	6	Nov. 1915	5	20.0	...	...	...	80.0	...	80.0	Fire killed.
"	"	...	Fort Collins, Colorado	4	1914	10	80.0	...	70.0	...	10.0	...	...	Fire killed in 1892.
Fir, Douglas	"	...	Flagstaff, Arizona	2	Nov. 1912	12	100	...	...	...	...	...	...	Cut from dead tree.
Gum, Black	Brush	C. T. C.	Clemson College, S. C.	5-1/2 - 6	Jan. 1915	8	12.5	...	...	...	50.0	25.0	12.5	Butts 3 coats - tops 2 coats
"	Charred	...	"	5-1/2 - 6	"	8	...	...	...	...	...	100.	...	
"	Open tank	C. T. C.	Calhoun, Louisiana	5 - 7	"	60	100	...	...	...	...	...	...	Entire post treated.
"	"	"	College Park, Md.	6	Nov. 1914	36	94.5	...	...	5.6	...	...	...	" " "
"	"	"	"	6	"	6	100	...	...	...	...	...	...	Single tank.
"	"	"	Clemson College, S. C.	5-1/2 - 6	Jan. 1915	3	33.0	...	...	...	67.0	...	...	" -Tops soaked in cold oil for short time.
"	"	U. S. T.	College Park, Md.	6	Nov. 1914	8	66.7	...	...	...	33.3	...	...	No cold bath.
"	Untreated	...	Clemson College, S. C.	5-1/2 - 6	Jan. 1915	2	...	...	...	...	100	...	...	
"	"	...	College Park, Md.	6	Nov. 1914	5	80.0	...	...	80.0	20.0	...	...	
Gum, Sweet	Open tank	C. T. C.	Lambert, Alabama	6-1/2	Nov. 1914	39	80.0	...	...	8.8	...	11.0	2.2	Piled on ground 7-1/2 years before setting. A number were treated while green.
"	"	"	Calhoun, Louisiana	5 - 7	Jan. 1915	177	96.1	1.7	1.1	...	1.1	...	...	Entire post treated.
"	"	"	Clemson College, S. C.	5-1/2 - 6	Jan. 1915	7	28.6	...	...	...	14.2	57.2	...	
"	"	"	College Park, Md.	6	Nov. 1914	73	82.2	5.4	7.0	...	5.4	...	5.4	Entire post treated.
"	"	"	"	6	"	6	100	...	...	...	...	...	...	Single tank.
"	"	"	"	6	"	11	72.7	...	...	27.3	...	...	...	Hot bath crude petroleum - 8 posts received no cold bath or creosote.
"	Untreated	...	Clemson College, S. C.	5-1/2 - 6	Jan. 1915	1	...	...	...	...	100	...	...	
"	"	...	College Park, Md.	6	Nov. 1914	5	40.0	...	...	...	60.0	...	...	
Gum, Tupelo	Open tank	C. T. C.	Calhoun, Louisiana	5 - 7	Jan. 1915	61	93.0	...	...	5.8	1.2	...	...	Entire post treated.
Hackberry	"	"	Ames, Iowa	6	June 1915	1	100	...	...	...	...	...	...	Butt treatment too short.
Hickory	Brush	"	Clemson College, S. C.	5-1/2 - 6	Jan. 1915	8	62.7	...	...	...	...	25.5	...	Butts 3 coats. Tops 2 coats.
"	Charred	...	"	5-1/2 - 6	"	8	...	...	...	...	...	100	...	
"	Open tank	C. T. C.	"	5-1/2 - 6	"	4	50.0	...	25.0	...	...	...	25.0	Single tank - tops soaked in cold oil.
"	Untreated	...	"	5-1/2 - 6	"	8	...	...	...	...	100	...	...	
Juniper, Alligator	"	...	Flagstaff, Arizona	2	Jan. 1913	10	100	...	...	...	...	...	...	Seasoned 2 months.
" One-seed	"	...	"	2	"	10	100	...	...	...	...	...	...	" " "
Locust, Black	Open tank	C. T. C.	College Park, Md.	6	Nov. 1914	34	100	...	...	...	...	...	...	Entire post treated.
"	"	"	"	6	"	9	100	...	...	...	...	...	...	Single tank.

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SERVICE TESTS OF TREATED AND UNTREATED POSTS OF VARIOUS SPECIES.—*(Continued.)*

Species	Method of Treatment		Location	Years of Service at Last Inspection	Date of Last Inspection	Total No. of Posts	% Sound	% Partly Decayed: Top	% Partly Decayed: Butt	% Decayed: Top	% Decayed: Butt	% Removed for Decay	% Not Inspected	Remarks
Locust, Black	Open tank	C. T. C.	College Park, Md.	6	Nov. 1914	5	100	...	...	...	...	...	...	Hot bath crude petroleum - cold bath C. T. C.
" "	Untreated	...	" " "	6	" "	26	96.2	...	...	...	3.8	...	...	20 of these were split posts.
Maple, Red	Open tank	C. T. C.	" " "	6	" "	57	92.4	...	5.3	...	2.7	...	...	Entire post treated.
" "	" "	" "	" " "	6	" "	12	91.7	...	...	...	8.3	...	...	Removed when fence was changed. Single tank.
" "	" "	" "	" " "	6	" "	5	80.0	...	20.0	...	...	20.0	...	Post treated neither cold bath nor creosote.
" "	Untreated	...	" " "	6	" "	5	60.0	...	...	...	...	...	40.0	Not bath crude petroleum.
Maple, Soft	Open tank	C. T. C.	Cabin John, Md.	9-1/2	" "	22	47.8	43.5	...	8.7	...	...	...	Impregnated by Mr. C. B. MacDonald.
Maple, Sugar	" "	" "	Rumbra Heights, Miss.	7-1/2	July 1914	40	95.8	2.8	...	2.8	2.8	...	...	Entire post treated. 3 split posts - 2 posts in cold oil only.
" "	" "	" "	" " "	7-1/2	" "	1	100	...	...	...	...	...	...	
Oak, Chestnut	" "	" "	College Park, Md.	6	Nov. 1914	13	84.7	...	15.3	...	...	...	...	Entire post treated.
" "	" "	" "	" " "	6	" "	25	100	...	...	...	...	...	...	Hot bath crude petroleum - cold bath C. T. C.
" "	" "	J. C. T.	" " "	6	" "	1	100	...	...	...	...	...	...	Single tank.
" "	Untreated	...	" " "	6	" "	5	...	...	20.0	...	60.0	...	...	
Oak, Coastal	"	...	Flagstaff, Arizona	2	Jan. 1913	10	100	...	...	...	...	...	...	Seasoned 6 months
Oak, Pin	Open tank	C. T. C.	College Park, Md.	6	Nov. 1914	14	94.4	...	5.6	...	...	...	...	Entire posts treated
" "	" "	" "	" " "	6	" "	14	71.4	...	28.6	...	...	...	...	Single tank.
" "	" "	" "	" " "	6	" "	10	100	...	...	...	...	...	...	Hot bath crude petroleum - cold bath C. T. C.
" "	Soaking	" "	" " "	6	" "	5	80.0	...	20.0	...	...	...	...	No cold bath.
Oak, Post	Brush	C. T. C.	Clemson College, S. C.	5-1/2 - 6	Jan. 1916	15	93.3	...	6.7	...	60.0	...	...	Butts 3 coats - tops 2 coats.
" "	Open tank	" "	" " "	5-1/2 - 6	" "	89	78.9	6.1	1.7	5.6	7.9	18.6	...	Entire post treated. Half double tank - half single
" "	" "	" "	" " "	5-1/2 - 6	" "	11	100	...	...	...	...	...	...	Split posts. Entire post treated - half double tank and half single.
" "	Untreated	...	" " "	5-1/2 - 6	" "	1	100	...	...	...	...	...	...	
" "	"	...	" " "	5-1/2 - 6	" "	2	50.0	...	...	...	50.0	...	...	Split posts.
Oak, Red	Open tank	C. T. C.	Ames, Iowa	5-1/2	Jan. 1913	5	...	20.0	20.0	...	40.0	...	...	Butt treatment too short.
" "	" "	" "	Clemson College, S. C.	5-1/2 - 6	Jan. 1913	10	80.0	10.0	...	...	10.0	20.0	...	Entire post treated.
" "	" "	" "	College Park, Md.	6	Nov. 1914	20	90.0	...	10.0	...	...	...	...	" " "
" "	" "	" "	" " "	6	" "	5	60.0	...	60.0	...	...	...	...	Single tank.
" "	" "	J.C.T.&C.	" " "	6	" "	11	100	...	...	...	...	...	...	
" "	" "	C. T. C.	Rumbra Heights, Miss.	7-1/2	July 1914	366	99.2	0.8	...	...	...	...	...	Entire post treated.
" "	" "	" "	" " "	7-1/2	" "	114	99.2	20.1	...	2.6	...	...	...	
" "	" "	J.C.T.&C.	" " "	7-1/2	" "	100	97.0	1.0	...	1.0	1.0	...	...	Entire post treated.
" "	" "	J. C. T.	" " "	7-1/2	" "	52	73.6	73.6	...	3.8	...	...	...	
" "	Untreated	...	Clemson College, S. C.	5-1/2 - 6	Jan. 1913	1	...	...	...	...	100	...	...	
" "	"	...	College Park, Md.	6	Nov. 1914	5	60.0	...	...	...	40.0	...	...	
Oak, Valley	"	...	Cal. National Forest	2	July 1913	158	99.3	...	...	C.8	...	...	...	Unseasoned posts.
Oak, White	Open tank	C. T. C.	College Park, Md.	6	Nov. 1914	44	88.6	...	11.4	...	...	...	...	Entire post treated.
Oak, White	" "	" "	" " "	6	Nov. 1914	8	100	...	...	...	...	...	...	Single tank.
" "	" "	" "	Rumbra Heights, Miss.	7-1/2	July 1914	4	100	...	...	...	...	...	...	Entire post treated.
" "	Untreated	...	College Park, Md.	6	Nov. 1914	5	80.0	...	20.0	...	20.0	...	...	
Pine, Jack	Brush	Carbolineum	University Farm, Minn.	6	Nov. 1914	7	28.6	...	71.4	...	...	...	...	2 coats.
" "	Dip	"	" " "	6	Nov. 1914	10	70.0	...	30.0	...	...	...	...	2 minute dip.
" "	Brush	C. T. C.	" " "	6	" "	5	80.0	...	20.0	...	...	...	...	2 coats.
" "	Dip	"	" " "	6	" "	10	70.0	...	30.0	...	...	...	...	2 minute dip.
" "	Open tank	"	" " "	6	" "	20	85.0	...	15.0	...	...	...	...	Hot bath 2 hours.
" "	" "	"	" " "	6	" "	7	85.7	...	14.3	...	...	...	...	Hot bath 1/2 hour - cold 3/4 hour.
" "	" "	"	" " "	6	" "	6	100.7	...	85.3	...	...	...	...	" " " Entire post tr'd.
" "	" "	"	" " "	6	" "	4	100	...	...	...	...	...	...	Started in hot C.T.C. and left to cool over night.
" "	Untreated	...	" " "	6	" "	18	11.1	...	88.9	...	...	...	...	
Pine, Limber	"	...	Flagstaff, Arizona	2	Nov. 1912	15	100	...	...	...	...	...	...	Cut from dead tree.
Pine, Loblolly	Open tank	C. T. C.	Calhoun, Louisiana	6 - 7	Jan. 1913	222	88.4	5.0	1.8	...	3.1	...	...	Entire post treated.
Pine, Lodgepole Low Prec- aure	" "	" "	Rocker, Montana	1	July 1914	616	100	...	...	...	...	...	...	Entire post treated. Penetration light & uneven.
" "	Open tank	" "	Routt County, Colorado	6	Nov. 1914	8	64.7	...	35.3	...	...	...	...	Hot bath - over night cooling - fire killed - Seasoned 27 years.
" "	" "	" "	" " "	6	Nov. 1914	22	71.4	5.6	21.4	...	...	...	2.6	Hot bath -fire killed - seasoned 27 years.
" "	" "	" "	" " "	6	" "	2	20.0	...	40.0	...	...	...	40.0	Hot bath - short cooling - fire killed - seasoned 27 years.
" "	Brush	Crude oil	Fort Collins, Colorado	4	1916	20	10.0	...	20.0	...	20.0	20.0	...	2 coats hot crude oil, 12 hours apart. Fire killed.
" "	"	J. C. T.	" " "	4	1916	20	20.0	...	20.0	...	...	...	...	2 coats - Fire killed in 1892.
" "	Open tank	"	" " "	4	1916	20	80.0	...	15.0	...	...	...	5.0	Hot bath 2 hours. Fire killed in 1892.
" "	" "	"	" " "	4	1916	20	100	...	...	...	...	...	...	Hot bath 2 hours-Cold 20 hrs. Fire killed in 1892.
" "	" "	"	" " "	4	1916	20	95.0	...	...	...	...	...	5.0	Hot bath 1 hr. - Cold 2-2/3Hrs. " "
" "	Untreated	...	" " "	4	1916	20	...	...	20.0	...	80.0	95.0	...	Fire killed in 1892.

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SERVICE TESTS OF TREATED AND UNTREATED POSTS OF VARIOUS SPECIES.—*(Continued.)*

Species	Method of Treatment		Location	Years of Service to Last Inspection	Date of Last Inspection	Total No. of Posts	% Sound	% Partly Rotted: Tops	% Partly Rotted: Butts	% Decayed: Tops	% Decayed: Butts	% Decayed for Penny	% Not Inspected	Remarks
Spruce, Engelmann	Open tank	C. T. C.	Routt County, Colorado	6	Nov. 1916	5	80.0	...	20.0	...	...	...	...	Hot bath - short soaking - Fire killed - Seasoned 27 years.
" "	" "	" "	" " "	1	Sept. 1913	17	94.1	....	5.9	....	....	....	0.0	" " " " " "
" "	" "	" "	" " "	6	Nov. 1916	17	82.7	....	17.6	....	....	....	0.0	Hot bath - fire killed - Seasoned 27 years.
" "	" "	" "	" " "	1	Sept. 1913	19	89.5	....	5.3	....	....	....	10.5	" " " " " "
" "	" "	" "	" " "	6	Nov. 1916	19	100	....	....	....	....	....	....	Cut green - seasoned - hot bath.
" "	Brush	V. C. T.	Fort Collins, Colorado	4	1916	20	80.0	....	20.0	....	....	....	....	Cut green - seasoned 12 months.
" "	Open tank	" "	" " "	4	1916	20	85.0	....	10.0	....	10.0	....	5.0	Hot bath 2 hours - cut green - seasoned.
" "	" "	" "	" " "	4	1916	20	100	....	....	....	....	....	....	Hot bath 2 hours - cooled 20 hrs. - cut green - seasoned.
" "	" "	" "	" " "	4	1916	20	90.0	....	5.0	....	....	....	5.0	Hot bath 2 hrs. - cooled 1-2/3 hrs. - cut green - seasoned.
" "	Untreated	...	Routt County, Colorado	6	Nov. 1916	9	...	....	33.3	....	66.7	....	...	Fire killed - Seasoned 27 years.
" "	"	...	" " "	1	Sept. 1913	9	88.9	....	...	....	...	....	11.1	" " " "
" "	"	...	Fort Collins, Colorado	4	1916	20	80.0	....	20.0	....	20.0	20.0	...	Cut green - seasoned.
Sycamore	Open tank	C. T. C	College Park, Md.	4	Nov. 1914	20	95.0	....	5.0	....	....	....	....	Entire post treated.
" "	" "	" "	" " "	4	" "	20	95.0	....	5.0	....	....	....	....	Single tank.
" "	" "	" "	" " "	4	" "	20	100	....	....	....	....	....	....	Hot bath crude petroleum - cold bath C. T. C.
" "	" "	V.O.T.SC.	" " "	4	" "	20	100	....	....	....	....	....	....	
" "	Untreated	...	" " "	4	" "	20	75.0	....	...	....	....	....	25.0	
Willow, Black & White	Open tank	C. T. C.	" " "	4	" "	20	88.7	....	11.3	....	....	....	....	Entire post treated.
" " " "	" "	" "	" " "	4	" "	20	93.4	....	6.6	....	....	....	....	Single tank.
" " " "	" "	" "	" " "	4	" "	20	80.0	....	20.0	....	20.0	....	....	Hot bath crude petroleum - 2 posts poorly treated.
" " " "	" "	" "	" " "	4	" "	20	80.0	....	20.0	....	20.0	....	....	Hot bath semi-liquid asphaltum. Cold bath C.T.C.
" " " "	" "	S. L. A.	" " "	4	" "	20	80.0	....	20.0	....	20.0	....	....	Hot bath only. Practically no penetration.
" " " "	" "	V.O.T.SC.	" " "	4	" "	20	100	....	....	....	....	....	....	
" " " "	Untreated	...	" " "	4	" "	20	80.0	....	20.0	....	....	....	....	
Willow, White	Open tank	C. T. C.	Ames, Iowa	5-1/2	June 1913	64	84.0	2.0	7.0	88.0	11.0	....	....	
" "	" "	" "	Oskaloosa, Iowa	5-1/2	Oct. 1914	9	...	88.8	...	66.6	....	....	....	Inspected by Mr. G. B. MacDonald.
" "	" "	" "	Fort Atkinson, Iowa	7-1/2-8-1/2	" "	9	100	....	....	....	....	....	....	" " " " " " - 6 hr. hot bath
" "	" "	" "	" " "	"	" "	"	"	"	"	"	"	"	"	Several hours cold.
" "	" "	" "	Waukomis, Iowa	5-1/2	" "	"	"	"	"	"	"	"	"	Inspected by Mr. G. B. MacDonald.
Tecomtain	" "	" "	Clemson College, S. C.	6-1/2 - 8	Jan. 1916	63	61.8	14.6	6.7	84.7	8.8	7.0	22.8	Entire post treated. Made up of 16 ichlolly, 7 yellow pine, 10 yellow poplar, 10 black gum - Species of individual posts not determined, however.

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SERVICE TESTS OF TREATED AND UNTREATED POSTS OF VARIOUS SPECIES.—*(Concluded.)*

Species	Method of Treatment	Location	Years of Service at Last Inspection	Date of Last Inspection	Total No. of Posts	% Sound	% Partly Decayed (Ground Line)	% Decayed (Ground Line)	% Removed for Decay	% Re-treated	Remarks
Pine, Longleaf & short-leaf	Open tank: Antimagnin	Cleveland, Texas	8	Dec. 1916	12	...	...	100	...	...	Antimagnin 0.12 per cent. Entire post treated.
" " "	" " "	" "	8	" "	12	8.3	...	58.4	...	...	" 0.25 " " " " "
" " "	" " "	" "	8	" "	12	...	...	100	...	...	" 0.50 " " " " "
" " "	Painted: Carbolineum C. T. C.	" "	8	" "	12	50.0	...	33.3	...	...	
" " "	" " "	" "	8	" "	6	50.0	...	16.7	...	...	Burnett creosote used.
" " "	Full cell: " "	" "	8	" "	12	...	...	100	...	...	German creosote used.
" " "	Ruping "	" "	8	" "	12	100	...	...	...	...	
" " "	Painted: Wood Creosote	" "	8	" "	12	...	...	100	...	...	Lyster wood creosote used. Entire post treated.
" " "	" Locustine	" "	8	" "	12	...	...	100	...	...	Entire post treated.
" " "	" R.I.W. Fill29; & R.I.W. 249;	" "	8	" "	9	...	...	88.9	...	...	Entire post treated. Painted with 1 coat R.I.W. Fill29 and one coat R.I.W. 249.
" " "	Open tank: Sodium silico-fluoride	" "	8	" "	13	92.3	...	7.7	...	...	Entire post treated. Sodium silico fluoride 1%
" " "	" "	" "	8	" "	14	78.6	...	21.4	...	...	" " " " " " 2%
" " "	Untreated: ...	" "	8	" "	12	...	...	100	...	...	
" " "	Open tank: Zinc Chloride	" "	8	" "	11	100	...	...	...	...	Entire post treated. Zinc chloride 2 per cent.
" " "	" " "	" "	8	" "	11	100	...	...	...	...	" " " " " " 0.5 per cent.
Pine, Miscellaneous	Brush: C. T. C.	Clemson College, S. C.	6-1/2 - 6	Jan. 1918	58	82.8	1.4	8.8	1.4	15.5	50.3	4.9	Butts 2 coats - tops 1 coats.
" " "	Open tank: " "	" "	6-1/2 - 6	" "	56	80.8	...	8.9	...	...	...	10.4	Entire post treated.
Pine Oldfield	Charred: ...	" "	6-1/2 - 6	" "	1	...	...	...	...	...	100	100	
" "	Open tank: C. T. C.	" "	6-1/2 - 6	" "	261	92.0	5.8	1.8	0.8	1.5	12.6	5.0	Entire post treated.
" "	Untreated: ...	" "	6-1/2 - 6	" "	2	...	...	...	...	...	50.0	...	
Pine, Scrub	Open tank: C. T. C.	College Park, Md.	6	Nov. 1914	25	96.4	...	3.6	...	...	...	...	Entire post treated.
" "	" "	" "	6	" "	10	100	...	...	...	...	...	...	Hot bath crude petroleum - cold bath C. T. C.
" "	" "	" "	6	" "	11	100	...	...	...	...	...	...	Hot bath semi-liquid asphaltum. Cold bath C. T. C.
" "	Soaking: S. L. A.	" "	6	" "	5	80.0	...	20.0	...	60.0	...	...	No cold bath. Practically no penetration.
" "	Open tank: W. G. T.	" "	6	" "	14	92.9	...	7.1	...	...	...	...	No cold bath.
" "	Untreated: ...	" "	6	" "	5	40.0	...	60.0	...	20.0	...	...	
Pine, western yellow	Untreated: ...	Mud Island, Miss.	3	1918	200	...	...	...	...	100	...	...	
" "	Untreated: ...	Flagstaff, Arizona	2	Jan. 1913	93	100	...	...	...	...	...	...	Seasoned posts.
Pine, Yellow	Charred: ...	Clemson College, S. C.	6-1/2 - 6	Nov. 1917	17	100	...	...	...	...	100	...	6 posts seasoned, 6 green, 6 cut from dead tree.
" "	Open tank: C. T. C.	Auburn, Alabama	6-1/2	Jan. 1918	2	...	...	...	...	...	...	...	
" "	" " "	" "	6-1/2	" "	83	84.5	14.1	9.1	...	6.1	12.1	6.1	Piled on ground 5-1/2 years - some treated green.
" "	" " "	" "	6-1/2	" "	44	86.0	2.3	4.5	...	2.3	...	6.1	" " " " " "
" "	Untreated: ...	Clemson College, S. C.	6-1/2 - 6	" "	190	77.7	6.8	1.6	...	...	6.8	6.8	Split posts.
" "	" ...	" "	6-1/2 - 6	" "	2	...	...	...	...	...	...	...	Entire post treated.
Pinus	Untreated: ...	Flagstaff, Arizona	1	Jan. 1913	10	100	...	...	...	67.0	33.0	...	
Poplar	Dip: Carbolineum	University Farm, Minn.	6	Nov. 1914	1	...	...	100	...	...	...	...	Removed 6 months.
" "	" C. T. C.	" "	6	" "	2	...	...	100	...	...	...	...	2 minute dip
" "	Open tank: "	" "	6	" "	2	100	...	...	...	...	...	...	2 minute dip
" "	" "	" "	6	" "	2	100	...	...	...	...	...	...	Started hot and left over night to cool.
" "	" "	" "	6	" "	4	100	...	...	...	...	...	...	Hot bath 1/2 hour.
Poplar Silver	" "	College Park, Md.	6	1914	20	85.0	...	15.0	...	...	...	...	Entire post treated.
" "	" "	" "	6	" "	10	90.0	...	...	...	10.0	...	...	Single tank.
" "	" "	" "	6	" "	5	80.0	...	20.0	...	20.0	...	...	Hot bath crude petroleum -irregular penetration.
" "	W.S.P.Co.	" "	6	" "	4	100	...	...	...	...	...	...	
" "	Untreated: ...	" "	6	" "	5	80.0	...	20.0	...	60.0	...	...	
Poplar Yellow	Brush: C. T. C.	Clemson College, S. C.	6-1/2 - 6	Jan. 1918	10	...	...	...	...	100	...	...	Butts 2 coats - tops 1 coats.
" "	Open tank: "	Auburn, Alabama	6-1/2	" "	10	100	...	...	...	...	...	...	Piled on ground 5-1/2 years. Split posts - Entire post treated.
" "	" "	Clemson College, S. C.	6-1/2 - 6	" "	17	76.4	5.9	5.9	...	5.9	5.9	...	Entire post treated
" "	" "	College Park, Md.	6	Nov. 1914	41	97.6	2.4	...	...	...	...	...	Single tank
" "	Untreated: ...	" "	6	" "	5	100	...	...	...	...	...	...	
Sassafras	" ...	" "	6	" "	1	100	...	...	...	...	...	...	
Spruce	Brush: Carbolineum	University Farm, Minn.	6	Nov. 1914	5	80.0	...	20.0	...	...	...	...	2 coats.
" "	Dip: "	" "	6	" "	9	44.4	...	55.6	...	...	...	...	2 minute dip.
" "	Brush: C. T. C.	" "	6	" "	8	66.7	...	33.3	...	...	...	...	2 coats
" "	Dip: "	" "	6	" "	8	50.0	...	50.0	...	...	...	...	2 minute dip
" "	Open tank: "	" "	6	" "	12	83.3	...	16.7	...	...	...	...	Hot bath 2 hours.
" "	" "	" "	6	" "	5	20.0	...	80.0	...	...	...	...	Hot bath 1/2 hour Cold bath 5/6 hr.
" "	Untreated: ...	" "	6	" "	10	80.0	...	20.0	...	...	...	...	
Spruce Engelmann	Brush: Crude Oil	Fort Collins, Colorado	6	1916	50	100	...	00.0	...	00.0	...	...	2 coats hot oil, 12 hours apart. Cut green - Seasoned.
" "	Open tank: " "	South County, Colorado	1	Sept. 1911	8	100	...	...	...	...	...	...	Hot bath - over night cooling - Fire killed- Seasoned 87 years.

[1] Posts cut at Cleveland, Texas are U.S.F.S. E. P. Wy. experiments. Data furnished by Mr. Geo. M. Ross, Manager, Treating Plants.

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THE PRESIDENT: This report, as Mr Gosline has stated, is merely a tabulation of data and facts. It occurs to me that there might be a good many members here who are in a position to make suggestions to the Committee, or offer some criticism, that would be of help to the Committee. We will now give you the opportunity.

MR. A. R. JOYCE: In connection with the report of the Committee on Service Tests, it is interesting to note the divergence of opinion among the wood-preservers, as to the kind and amount of treatment to be given ties. It is generally held that ties should be given sufficient treatment to prevent decay during the term of their mechanical life. On this point, one group of operators makes the statement that "the mechanical life of ties on our system is"—and then they detail it, and they say, "therefore the kind of treatment which we shall give ties will be"—and then they arrive at a certain conclusion. Another group of operators makes the statement that "under the service conditions of our systems, ties are failing mechanically"—therefore, this fact must be presented to the management fully, in order that steps may be taken to properly protect treated ties so that the full life of the treatment may be obtained.

In either event, such statements can only be made accurately by officers having full knowledge of the facts involved. It is generally conceded that accurate facts can be obtained better through the close observance of experimental stretches of track rather than through an attempt to keep a record of all ties in service.

In the final analysis, however, the maintenance of way records showing the annual renewals per mile per year, considered with due regard to the cost per tie, on a system where the trackage is adequately maintained, gives the answer as to the success or failure of the policies of the management in regard to tie renewals.

While facts obtained from experimental sections of track where ties are laid out of face, give valuable results, there may be a question in the minds of some operating officials as to whether the results obtained are the average results which may be expected on hundreds of thousands of ties so treated and installed.

I had the pleasure last year of inspecting a great many ties on one of the western trunk lines. I made some notes. Part of these ties were experimental ties, installed as such, various species of woods treated in various manners. Part of the ties were installed in the construction of new lines, not experimental tests at all, but average ties installed under average conditions.

Of the experimental ties we noted that the ties with straight creosote full cell had the best appearance, and ties treated with a mixture of zinc chloride and creosote were almost as good as straight

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creosote. This was after 6, 7, 8 or 9 years. The only difference between the ties treated with a mixture and ties treated with straight creosote was a slight tendency to check in the ties treated with a mixture. The zinc treated ties after 7 or 8 years showed up more surface checks and season cracks than either of the other two treatments. This is a very important fact and undoubtedly contributes to the failure of zinc-treated material in climates where the annual rainfall is a factor.

But aside from the experimental tracks which were installed as such, some very interesting facts were noticed. In one of the western states, in a track 14 miles long, constructed in 1900, zinc-treated lodge pole-pine ties were laid in gravel ballast, 75-lb. rail, no tie-plates except on curves. Rail changed in 1916 to 90-lb. at which time ties were cut with saws which were installed on a small handcar and adzed out between saw cuts for tie-plates. I had the pleasure of walking over two miles of this stretch of 14 miles that was laid out. These two miles were set aside and every tie counted. The ties were originally dated. On the basis of that count 93% of those zinc-treated ties have given to date 16 years' service. That is not experimental at all; it is average practice. The ties were treated in the ordinary way and installed under the ordinary conditions. The rail was changed this year and an occasional tie was removed. We examined closely a number of these ties, which showed no evidence of rot and no evidence of failure except for the rail cutting which was not serious enough to prevent these ties from being used again.

Just beyond this track 6 miles of fir ties untreated were laid in 1900 and the renewals began in 1905. All of these ties untreated had been removed by 1908. They failed on account of rot, and gave an average life of only 6 years. The normal annual rainfall for this track is 19 ins., and this compares with a normal annual rainfall in southern Illinois of 45 ins. and Northern Illinois of 40 inches. Then we went over a stretch of track of 90 miles. It was built in 1906. Ninety miles of track built in 1906 with zinc-treated fir and pine ties, and two miles of that 90 miles was set aside, and every tie was counted. In one of the miles one tie had been removed to date and in the other mile no ties had been removed to date, and on the entire 90 miles of these zinc-treated ties the renewals have been less than 600 ties in 10 years. That is for all causes, burn and breakage and derailment, or any cause whatsoever.

If the ties in these 90 miles of track should all fail in the eleventh year, the life of these zinc-treated ties has already proven the wisdom of their use, as the life which could be reasonably expected from untreated fir and pine in this climate is apparently 6 years.

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The normal annual rainfall for this stretch of track was from 10 to 14 inches. I think the normal annual rainfall statistics have a very important bearing in considering the records of zinc-treated ties.

When a man says zinc treatment, the question to ask him is what the normal annual rainfall is, and consider the two of them together.

A very interesting matter happened on one of these particular systems in relation to the lineup for the annual inspection of these tracks. The vice-president in charge of operation had issued instructions that on his annual trip of inspection the superintendent of timber preservation shall be accompanied by the division superintendent, the roadmaster and the section-foreman on each of these particular pieces of tracks, and also by a representative of the Maintenance-of-Way Department, an engineer. This establishes a community of interests, and each man acts as a check on the other, and the entire undertaking is carried on with due regard to its importance (applause).

MR. J. H. WATERMAN: Mr. Chairman, you have asked for suggestions for the Committee. I have a suggestion to make. The American Railway Engineering Association compiles statistics something like those presented. They usually send a man over one or more stretches of experimental tracks to examine the tracks, with the representative on that road. Now you know there is a long list here, and it refers to the Burlington system. I want to give one member of this Committee, that is, I would like to have this Committee select a member and I will give him a very cordial invitation to accompany me this year over any or all of the Burlington experimental tracks, and then he can see for himself. Sometimes we see things through our own eyes, and we get so enthusiastic we only see one side of it, and it is, I think, a nice thing to have a representative from this organization accompany, or go over part or all of the experimental sections. The Committee can divide it up among a number of the railroads represented here. I am not inviting members to go over the other roads, but I suggest it is a good proposition. If the member you elect to go with me will get in touch with me next August I will give you a timetable so you can know where I will be and on what dates.

THE PRESIDENT: If representatives of the different railroads who have experimental tracks will get in touch with our Committee and help them along such lines as Mr. Waterman, representing the Burlington, has offered to help them, it will certainly be of great assistance to our Committee and to our Association in collecting data, which is perhaps the most interesting data that we can put out to people who are considering treating timber.

MR. L. B. MOSES: I wonder if Mr. Joyce can tell us in connection with these reports on mountain pine in the 14-mile stretch he spoke

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of, whether these ties were tie-plated, and if so the dimensions of the tie-plates and weight of the rail.

MR. A. R. JOYCE: The ties were tie-plated on curves only. The plates were rather small. The ties all show evidence of rail cut. The original rail on most of this track was 75 pounds. It has since been changed to 90 pounds, and in talking with some of the roadmasters they seem to think that many of the ties that have failed, failed because they had not been properly protected. Now when you come to consider on the first stretch of track that 93% of those ties have already gone 16 years, and that at least 50% are going to go 20 years, when you talk about 7% that failed, the failure is so small it is pretty hard to tell just what effect the rail-cutting has. On tangents there were no tie-plates, and the original rail was 75 pounds.

MR. NELSON C. BROWN: Mr. President, I would like to ask Mr. Joyce what species of pine is that mountain pine he speaks of, and where it is cut?

MR. A. R. JOYCE: It is cut in the Black Hills and Big Horn Mountains.

MR. NELSON C. BROWN: That is the western yellow pine then?

MR. A. R. JOYCE: It is both lodgepole and western yellow pine.

THE PRESIDENT: Any further remarks? What action do you wish to take on this Committee's report?

MR. J. H. WATERMAN: I move you that the Committee's report be accepted, and we compliment them on the work they have done, and continue the same Committee, or not necessarily the same Committee, but continue a Committee on the same lines the next year.

THE PRESIDENT: Is there a second?

MR. F. J. ANGIER: I second the motion.

THE PRESIDENT: All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. H. M. ROLLINS: I would like to refer back to this report of the Committee. On page 88 you will notice a table at the top of the page.

THE PRESIDENT: What report is it, Mr. Rollins?

MR. H. M. ROLLINS: It is the report you have just received on Service Tests. I want to call your attention to a typographical error at the top of page 88, under the heading of "Ash Ties." You will notice in the bottom line, "Untreated, total ties placed, 116, total ties removed, 193."

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MR. F. J. ANGIER: We will make a correction there, Mr. Rollins. That is a printer's error, probably.

THE PRESIDENT: We will now have the report of the Committee on Plant Operation. I will ask the Secretary to read the names.

SECRETARY ANGIER: Mr. A. L. Kuehn, Chairman, Mr. Geo. M. Hunt, Mr. C. W. Lane, Mr. A. M. Lockett, Mr. Frank McArdle and Mr. August Meyer.

MR. A. L. KUEHN: We started here to make a little classification of the operations of a plant. We have to remember that such a thing is necessary to properly and systematically work out any standards or rules for plant operation. This can be readily carried on and be made a basis for accounting classifications. That, of course, is one of our important items. This is simply submitted as progress and information. The next three items, under "Methods of Measuring Quantities," "Plant Records" and "Methods of Determining Cubic Feet of Wood in a Charge," are submitted as progress and information, excepting that the Committee recommends for adoption and recommended practice the table on page 242. This table is the standard table for expansion of creosote, based on the unit volume at 100° F., and an expansion of 1% for every 22½° F. This is a table that I believe everybody is familiar with; it is old material, but I think that makes it ever so much more necessary to put it in the MANUAL OF RECOMMENDED PRACTICE. In addition to that table there is one item which was intended to be given as recommended for adoption, and we would like to submit that now, that is, that the standard measuring temperature for creosote oil be 100°. I would like to ask Mr. Hunt to lead the discussion on calculating the volume of poles and piles.

MR. GEO. M. HUNT: In looking up methods for calculating the volume of poles and piles, we came across a large number of methods. Some of the principal ones are described here, and the difference in results that you can get are noted.

On account of the fact that a pile or a pole is not uniform or regular in shape, you cannot expect to get the exact volume by any method which is practicable in a commercial treating plant where you are handling large numbers. You, therefore, have to use a method which is practicable and which will give you the nearest results to the correct one. We feel that the table on page 249 calculated by the formula given underneath it is the one which is the most practicable for general treating plant use. If in special cases anyone wants more accurate results, about the only thing he can do is to divide his pile up into short sections, that is, mark it off into short sections, and measure the diameter or the circumference at each end of each section, and then calculate those sections as separate pieces of wood, and get the

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total. The shorter you make those sections and the more careful are your measurements, the more nearly the exact results you will get.

For general work we believe the table will give you what you want. It is recommended by the Committee that this table be adopted to be printed in the MANUAL as recommended practice and recommended usage for the Association.

MR. A. L. KUEHN: The last item is with reference to Fuel and Power Consumption, and is a paper written by Mr. Lockett. We present this as information and for study.

REPORT OF COMMITTEE ON PLANT OPERATION.

To the Members of the American Wood-Preservers' Association:

The objects we wish to attain in the working of the plant are: First, good work; second, economical and efficient operation. These ends can be obtained only by study of the details of the operation. For such a study it is necessary to make a detailed classification of the various steps together with the various means of performing these steps. It is attempted here to present such a classification for criticism and further amplification.

In general, the work at a wood-preserving plant is grouped as follows:

1. Receiving and storage of material to be treated.
2. Transportation of the material.
3. Special manufacturing.
4. Steam and power generation.
5. Treating.
6. Shipping.
7. Keeping of records and accounting.

It must be remembered in studying various methods of performing any step that greatly varying conditions are to be met for various plants. It is, therefore, essential that the best manner of applying each method be studied rather than making general comparison of all methods. When the best way of working each method is known, the proper method for any particular case can readily be determined.

1. Receiving and Storage of Material to be Treated.

a. Entirely by manual labor.
b. By special conveyors.
c. By locomotive crane.
d. By fixed derrick.

2. Transporting Material.

a. Loading of tram cars by hand, locomotive crane, conveyor, fixed derrick.

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b. Transporting by cable, special steam locomotive, electric locomotive.

3. **Special Manufacturing.**
   - *a.* Paving blocks.
   - *b.* Boring and adzing of ties.
   - *c.* Framing of poles.
   - *d.* Manufacture of cross-arms.
   - *e.* Framing of timbers.

4. **Steam and Power Generation.**
   - *a.* Fuel supply, proper selection of fuel.
   - *b.* Boiler operation.
   - *c.* Water supply.
   - *d.* Electric power generation.

5. **Treating.**
   - *a.* Charging and discharging of retorts.
   - *b.* Pumping preservatives, by steam pump, by centrifugal pump, by air.
   - *c.* Storage and measuring of preservatives.
   - *d.* Operation of air, vacuum and pressure pumps.
   - *e.* Heating.

6. **Shipping.**

   Loading of material by hand, conveyors, locomotive crane fixed derrick.

7. **Keeping of Records.**
   - *a.* Recording of the steps at time of performance.
   - *b.* Compiling and reporting operations.

METHODS OF MEASURING QUANTITIES OF PRESERVATIVE USED AND THE MAKING OF INVENTORIES.

By August Meyer.

A correct checking of inventories on creosote can be obtained either by weighing or by measuring. However, where large quantities of creosote are on hand it would be a very difficult job to weigh out except when special arrangements are provided, and for this reason we are obliged in most cases to take inventories of creosote by measurements. In order to do so we must obtain the following four factors for our calculation, namely:

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1. The exact area of the tank containing the creosote.
2. The exact measurement of volume.
3. The temperature.
4. The coefficient of expansion.

To obtain the correct measurement of a quantity of creosote in a tank it is not advisable to rely on a gauge reading alone even if we have a good assurance that the gauge is correct. We must check this gauge reading.

The matter of obtaining the correct mean temperature of a tank of creosote is most important. Since the standard measuring temperature is now generally accepted as 100° F., it is desirable to measure a volume of creosote as nearly as possible at this temperature since

FACTORS TO BE USED FOR DETERMINING THE VOLUME OF CREOSOTE AT 100° F., WHEN THE OIL IS AT TEMPERATURES RANGING FROM 60° TO 225° F.

Temp. Fahr.	Factor.	Temp. Fahr.	Factor.	Temp. Fahr.	Factor.	Temp. Fahr.	Factor.
60	0.9822	102	1.0009	144	1.0196	186	1.0382
1	0.9827	3	1.0013	5	1.0200	7	1.0387
2	0.9831	4	1.0018	6	1.0204	8	1.0391
3	0.9836	5	1.0022	7	1.0209	9	1.0396
4	0.9840	6	1.0027	8	1.0213	190	1.0400
5	0.9845	7	1.0031	9	1.0218	1	1.0404
6	0.9849	8	1.0036	150	1.0222	2	1.0409
7	0.9853	9	1.0040	1	1.0227	3	1.0413
8	0.9858	110	1.0045	2	1.0231	4	1.0418
9	0.9862	1	1.0049	3	1.0236	5	1.0422
70	0.9867	2	1.0053	4	1.0240	6	1.0427
1	0.9871	3	1.0058	5	1.0245	7	1.0431
2	0.9876	4	1.0062	6	1.0249	8	1.0436
3	0.9880	5	1.0067	7	1.0253	9	1.0440
4	0.9885	6	1.0071	8	1.0258	200	1.0445
5	0.9889	7	1.0076	9	1.0262	1	1.0449
6	0.9894	8	1.0080	160	1.0267	2	1.0453
7	0.9898	9	1.0085	1	1.0271	3	1.0458
8	0.9902	120	1.0089	2	1.0276	4	1.0462
9	0.9907	1	1.0094	3	1.0280	5	1.0467
80	0.9911	2	1.0098	4	1.0285	6	1.0471
1	0.9916	3	1.0102	5	1.0289	7	1.0476
2	0.9920	4	1.0107	6	1.0294	8	1.0480
3	0.9925	5	1.0111	7	1.0298	9	1.0485
4	0.9929	6	1.0116	8	1.0302	210	1.0489
5	0.9934	7	1.0120	9	1.0307	1	1.0494
6	0.9938	8	1.0125	170	1.0311	2	1.0498
7	0.9943	9	1.0129	1	1.0316	3	1.0502
8	0.9947	130	1.0134	2	1.0320	4	1.0507
9	0.9951	1	1.0138	3	1.0325	5	1.0511
90	0.9956	2	1.0143	4	1.0329	6	1.0516
1	0.9960	3	1.0147	5	1.0334	7	1.0520
2	0.9965	4	1.0151	6	1.0338	8	1.0525
3	0.9969	5	1.0156	7	1.0343	9	1.0529
4	0.9974	6	1.0160	8	1.0347	220	1.0533
5	0.9978	7	1.0165	9	1.0351	1	1.0538
6	0.9983	8	1.0169	180	1.0355	2	1.0542
7	0.9987	9	1.0174	1	1.0360	3	1.0547
8	0.9992	140	1.0178	2	1.0365	4	1.0551
9	0.9996	1	1.0183	3	1.0369	5	1.0556
100	1.0000	2	1.0187	4	1.0373	...	.....
1	1.0004	3	1.0192	5	1.0378	...	.....

Explanation: To determine the volume at 100° F., divide the volume at any temperature by the factor corresponding to that temperature in the above table.

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this reduces the errors due to expansion correction. However, it is usually necessary to heat the oil higher than 100° F. in order to be sure that the entire volume is liquid. It is most important that enough observations of temperature be taken to get as nearly as possible the true average temperature.

It is important in order to arrive at true volumes that the creosote measured is liquid. It is impossible, however, to liquefy sludge which has settled in the bottom of the storage tanks, and it is, therefore, desirable to have some simple stirring or agitating arrangement, so that this sludge may be kept dissolved. It is also desirable, therefore, to have heating coils as near as possible to the tank bottom.

As stated, in order to make an accurate measurement, the coefficient of expansion should be fairly accurately known, This coefficient will vary for various oils and mixtures. The expansion coefficient of creosote is closely 0.00044, and below is a table of coefficients based on the volume at 100° F.

For other solutions such as zinc chloride the number of cubic feet of solution in a tank must first be found in the same manner as for creosote. After this is done the weight per cubic foot and the strength of the solution must be determined.

There are several ways to determine the weight per cubic foot of a solution, either by weighing a cubic foot direct or by finding its specific gravity by means of a specific gravity bottle or a hydrometer.

The strength of a solution is determined either by chemical analysis or by hydrometers made especially for this kind of work, and various tables giving the strength of a solution at different temperatures can easily be obtained, for example, the tables made by Samuel Rowe & Son, and others. Having obtained the number of cubic feet of solution in the tank, its weight per cubic foot and strength, the number of pounds of dry zinc chloride this solution contains will be known.

PLANT RECORDS.

By August Meyer.

Correct records covering the operation of a plant seems to me a matter which must be left to the management of each individual plant to solve, because few commercial plants are operated under similar conditions and it is a fact that a private plant will never require the same records as a plant owned and operated by a railroad. There are, however, certain records which ought to be kept at every timber-treating plant. These records should cover everything pertaining to the material treated, such as date received in yard, condition of material,

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either seasoned or unseasoned, time of storage in yard, when it was treated, by what process, the condition of the material before and after treatment, a treating report giving in detail the whole operations of the treatment and last, but not least, all comments from the owners of the material and the management of the plant. To illustrate:

Very often an operator is called upon to treat material which is not in the proper condition for treatment, or perhaps is asked to give this material a treatment which will do it more harm than good, and although there may be objections against it at the time, still the material is treated over the operator's objections and a few years later when the material fails the operator of the plant will be blamed because he cannot bring forth the records which show who in reality is to blame for the unsuccessful treatment.

METHODS OF DETERMINING CUBIC FEET OF WOOD IN A CHARGE.

By August Meyer.

There are three methods by which we may arrive at the approximate number of cubic feet in a charge, namely:

(1.) By displacement in retort.
(2.) By weighing.
(3.) By measuring.

The first, and perhaps the best known method for determining the number of cubic feet in a charge, seems very unreliable on account of the irregularity by which a charge of timber absorbs the preservatives during filling.

The second method is to weigh and measure a certain number of ties and from the figures obtained calculate the average weight per cubic foot. By weighing each charge before treating, using the average weight per cubic foot as a base for calculating the number of cubic feet, a fair result may be obtained providing all the ties to be treated have the same amount of seasoning, are of the same kind of wood, and weather conditions remain the same. If this is not the case, very erroneous results may also be obtained by this method. There is, of course, one good point in using this method which ought not to be overlooked, and that is by weighing the charge again after treating, a check on the actual absorption is obtained.

The third method, which seems the most practical and by which the most reliable information can be obtained, is to measure a large number of ties after they are loaded on trams and from the figures thus obtained calculate the average number of cubic feet per tie and per tram and use these results as an arbitrary figure for each charge. The larger the number of ties measured of the different kinds of wood, the more reliable will be the result.

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CALCULATING THE VOLUME OF POLES AND PILES.

By Geo. M. Hunt.

There are a number of ways to obtain the volume of poles, piles, and other round timbers. The most accurate way would be to submerge the pile in some substance which would fill all the checks, but would not be absorbed by the wood. This, of course, is in general impracticable, and for ordinary treating plant work the simplest way is to measure the diameter at a number of points and calculate the volume from a formula or a volume table.

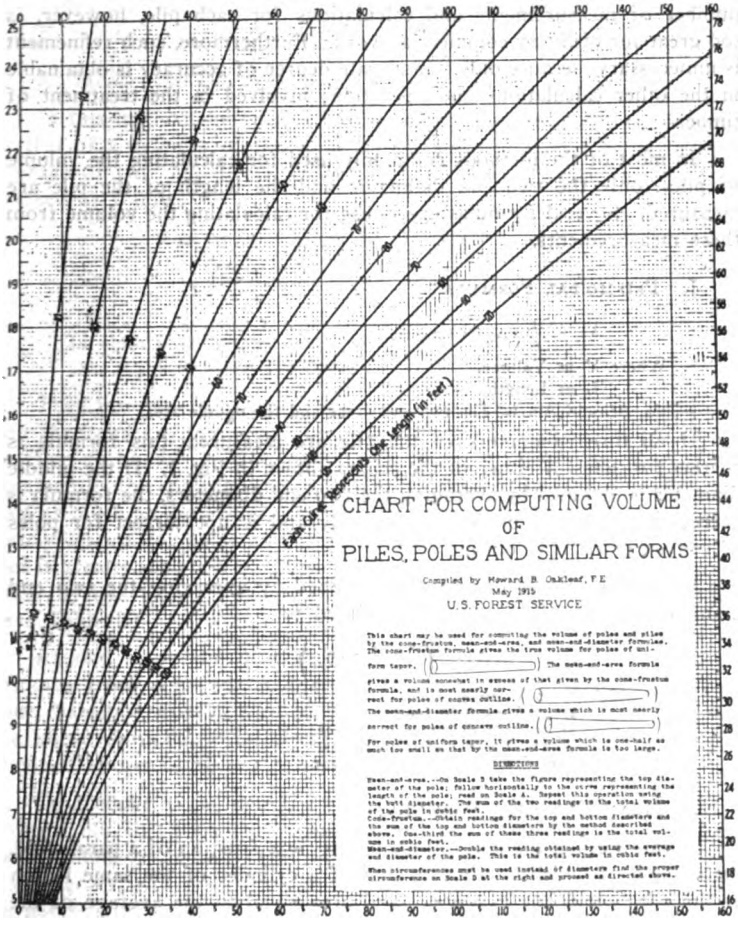
CHART FOR COMPUTING VOLUME
OF
PILES, POLES AND SIMILAR FORMS
Compiled by Howard R. Oakleaf, F.E.
May 1915
U.S. FOREST SERVICE
Each Curve Represents One Length (in Feet)

Fig. 1.

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A number of possible errors are introduced in obtaining the volume from these measurements. In the first place, the pile is assumed to be round, which is seldom the case. It is also assumed that there are no irregularities in its contour between the points at which the measurements are taken, and no allowance is made for checks so that in the case of seasoned timber the volume of all checks is calculated as wood.

If the circumference measurements are taken at short intervals and the volume of each short section is computed separately the greatest degree of accuracy is obtained. The inconvenience of making a large number of measurements and calculations for each pile, however, is too great for ordinary commercial work. Furthermore, such refinement is unnecessary, because only a moderate degree of accuracy is obtainable in the other calculations and operations involved in the treatment of timber.

In most of the methods commonly used for calculating the volume of piles, only the two end diameters and the length of the pile are measured. Several formulas are in use for calculating the volume from these measurements.

1. PRISMOIDAL FORMULA:

$$V = \frac{L}{6}(A_1+4Am+A_2)$$

Where V = Volume.
L = Length.
A_1, A_2, and Am = The two end areas and the middle area.

If all three diameters of the pile are measured, this formula is correct for poles of either of the shapes shown in Fig. 1. If the middle diameter is obtained by averaging the two end diameters, the formula is correct for poles of uniform taper only and is not correct for poles of convex or concave outline.

When the middle diameter is obtained by averaging the two end diameters the formula may be simplified to:

$$V = 0.2618\ L\ \left(\frac{D^2+d^2+Dd}{144}\right)$$

In which V = Volume.
L = Length in feet.
D = Butt diameter in inches.
d = Top diameter in inches.
This is correct for the frustum of a cone.

2. MEAN END AREA FORMULA:

In this method the pole is assumed to be a frustum of a paraboloid, the volume of which is equal to that of a cylinder of the same length as the paraboloid but having a basal area equal to the average of the areas of its two ends. The formula is:

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$$V = L \left(\frac{A_1 + A_2}{2}\right)$$

In which L = Length.
A_1 and A_2 = The two end areas.

The volume of the pole can be calculated by this formula in less than half the time required by the prismoidal formula, but the values obtained are always somewhat greater than by the prismoidal formula. This value is most nearly correct for piles of convex outline. It has been found that where the small diameter is greater than 0.78 of the large diameter the volume by the mean area formula will differ by less than 1% from the volume by the cone frustum formula. (See Table 1.)

3. MEAN END DIAMETER FORMULA:

In this method the volume of the pile is assumed to be equivalent to that of a cylinder of the same length and a diameter equal to the average of two end diameters of the pile. The formula may be expressed as follows:

$$V = \frac{\pi}{11} L \left(\frac{d}{2}\right)^2$$

$$= \frac{\frac{\pi}{11} L d^2}{4}$$

$$= .7854\ L\ d^2$$

In which L = Length.
d = Mean diameter.

This formula is easier to use than the mean end area formula and the results obtained are nearer to the results given by the cone frustum formula. It gives a volume which is always less than that obtained by the cone frustum formula, but differs from it by only one half as much as the values given by the mean end formula. It is most nearly correct for poles of a concave outline. Where the small diameter is greater than 0.70 of the large diameter, the results by this method differ by less than 1% from the results by the cone frustum formula (see Table 1.)

At one plant, the diameters are measured at ⅓ and ⅔ of the distance from one end, in addition to the two end diameters. The four diameters can then be averaged and the mean diameter used in the above formula. The result should be more accurate than that obtained by averaging the two end diameters only.

On account of the more or less irregular shape of piles and poles, no formula for a regular shaped solid can be expected to give the exact volume of an individual pile or pole. Either of the above formulas, however, will generally give results sufficiently close for ordinary purposes, unless the top diameter is very much smaller than the butt diameter.

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Table 1 shows the relation between the volumes obtained by Formulas 1, 2, and 3, for poles varying from a true cone to a true cylinder. The volume by the cone frustum formula is taken as unity in each case in the table. The volume by either of the other formulas may be obtained by multiplying the volume given by the cone frustum formula by the factor given under the respective formula. The table shows that where the top diameter is very much smaller than the butt diameter the three formulas give widely varying results. As the top diameter becomes more nearly equal to the butt diameter, however, the three formulas give results which are more nearly the same.

The volume table (Table 2) which follows was calculated by the cone frustum formula (No. 1). If more accurate results are required, the pile should be laid off in a number of short sections, and the volume of each section calculated.

In measuring diameters it will frequently be found that the end of the pile is not a true circle. A figure representing as nearly as possible the average diameter of the end should be taken.

TABLE I.—RELATION OF VOLUME BY MEAN END AREA AND MEAN END DIAMETER FORMULAS TO THAT BY CONE FRUSTUM FORMULA.

Ratio of Top Diameter to Butt Diameter	FACTORS FOR		
	Cone Frustum Formula.	Mean End Area Formula.	Mean End Diameter Formula.
0.0	1.00	1.500	0.750
.1	1.00	1.360	.820
.2	1.00	1.260	.870
.3	1.00	1.180	.910
.4	1.00	1.120	.940
.5	1.00	1.070	.960
.6	1.00	1.040	.980
.7	1.00	1.020	.990
.8	1.00	1.008	.996
.9	1.00	1.002	.999
1.0	1.00	1.000	1.000

The curves shown in Fig. 1, which were prepared by H. B. Oakleaf of the Forest Service, give the volume by all three methods described above.

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Find the average diameter at each end of the pile to the nearest half inch. Multiply the number in the table corresponding to these two diameters by the length of the pile in feet. The result is in cubic feet.

AVERAGE VOLUME PER FOOT OF LENGTH (Cubic Feet).

DIAMETER OF LARGE END—INCHES.

DIAMETER OF SMALL END—INCHES.	4	4½	5	5½	6	6½	7	7½	8	8½	9	9½	10	10½	11	11½	12	12½	13	13½	14	14½	15
4	.087																						
4½	.099	.110																					
5	.111	.123	.136																				
5½	.124	.137	.150	.165																			
6	.138	.151	.165	.180	.196																		
6½	.153	.167	.181	.197	.213	.230																	
7	.169	.183	.198	.214	.231	.249	.267																
7½	.186	.200	.216	.232	.250	.268	.287	.307															
8	.204	.219	.235	.251	.269	.288	.307	.328	.349														
8½	.222	.238	.254	.271	.290	.309	.329	.350	.371	.394													
9	.242	.258	.275	.292	.311	.330	.351	.372	.395	.418	.442												
9½	.262	.279	.296	.314	.333	.353	.374	.396	.419	.442	.467	.492											
10	.284	.300	.318	.337	.356	.377	.398	.420	.444	.468	.493	.519	.545										
10½	.306	.323	.341	.360	.380	.401	.423	.446	.470	.494	.520	.546	.573	.601									
11	.329	.347	.365	.385	.405	.427	.449	.472	.496	.521	.547	.574	.602	.630	.660								
11½	.353	.371	.390	.410	.431	.453	.476	.500	.524	.550	.576	.603	.631	.660	.690	.721							
12	.378	.397	.416	.437	.458	.480	.504	.528	.553	.579	.605	.633	.662	.691	.722	.753	.785						
12½	.404	.423	.443	.464	.486	.509	.532	.559	.582	.609	.636	.664	.693	.723	.754	.786	.819	.852					
13	.431	.450	.471	.492	.515	.538	.562	.587	.613	.640	.667	.696	.725	.756	.787	.819	.853	.887	.922				
13½	.459	.479	.500	.521	.544	.568	.592	.618	.644	.671	.700	.729	.759	.790	.821	.854	.888	.922	.958	.994			
14	.487	.508	.529	.551	.575	.599	.624	.650	.676	.704	.733	.762	.793	.824	.856	.890	.924	.959	.994	1.031	1.069		
14½	.517	.538	.560	.582	.606	.630	.656	.682	.710	.738	.767	.797	.828	.860	.892	.926	.960	.996	1.032	1.069	1.108	1.147	
15	.547	.569	.591	.614	.638	.663	.689	.716	.744	.772	.802	.832	.864	.896	.929	.963	.998	1.034	1.071	1.109	1.147	1.187	1.227
15½	.579	.600	.623	.647	.671	.697	.723	.750	.779	.808	.838	.869	.900	.933	.967	1.001	1.037	1.073	1.110	1.149	1.188	1.228	1.269
16	.611	.633	.656	.680	.705	.731	.758	.786	.815	.844	.875	.906	.938	.971	1.005	1.040	1.076	1.113	1.151	1.189	1.229	1.269	1.311
16½	.644	.667	.690	.715	.740	.767	.794	.822	.851	.881	.912	.944	.977	1.010	1.045	1.080	1.117	1.154	1.192	1.231	1.271	1.312	1.354
17	.678	.701	.725	.750	.776	.803	.831	.860	.889	.920	.951	.983	1.015	1.050	1.085	1.121	1.158	1.196	1.234	1.274	1.314	1.356	1.398
17½	.713	.737	.761	.787	.813	.840	.869	.898	.928	.959	.990	1.023	1.057	1.091	1.127	1.163	1.200	1.239	1.278	1.318	1.359	1.400	1.443
18	.749	.773	.798	.824	.851	.879	.907	.937	.967	.999	1.031	1.064	1.098	1.133	1.169	1.206	1.244	1.282	1.322	1.362	1.404	1.446	1.489
18½	.786	.810	.836	.862	.890	.918	.947	.977	1.008	1.039	1.072	1.106	1.140	1.176	1.212	1.249	1.288	1.327	1.367	1.408	1.449	1.492	1.536
19	.824	.849	.875	.901	.929	.958	.987	1.018	1.049	1.081	1.114	1.149	1.184	1.219	1.256	1.294	1.333	1.372	1.413	1.454	1.496	1.539	1.584
19½	.862	.888	.914	.941	.969	.999	1.029	1.059	1.091	1.124	1.158	1.192	1.228	1.264	1.301	1.339	1.379	1.419	1.459	1.501	1.544	1.588	1.632
20	.902	.928	.955	.982	1.011	1.040	1.071	1.102	1.134	1.168	1.202	1.237	1.273	1.309	1.347	1.386	1.425	1.466	1.507	1.549	1.593	1.637	1.682
20½	.942	.969	.996	1.024	1.053	1.083	1.114	1.146	1.179	1.212	1.247	1.282	1.319	1.356	1.394	1.433	1.473	1.514	1.556	1.599	1.642	1.687	1.732
21	.984	1.010	1.038	1.067	1.096	1.127	1.158	1.190	1.224	1.258	1.293	1.329	1.365	1.403	1.442	1.481	1.522	1.563	1.605	1.649	1.693	1.738	1.784
21½	1.026	1.053	1.081	1.110	1.140	1.171	1.203	1.236	1.269	1.304	1.339	1.376	1.413	1.451	1.490	1.530	1.571	1.613	1.656	1.699	1.744	1.789	1.836
22	1.069	1.097	1.125	1.155	1.185	1.217	1.249	1.282	1.316	1.351	1.387	1.424	1.462	1.500	1.540	1.580	1.622	1.664	1.707	1.751	1.796	1.842	1.889
22½	1.113	1.141	1.170	1.200	1.231	1.263	1.296	1.329	1.364	1.399	1.436	1.473	1.511	1.550	1.590	1.631	1.673	1.716	1.759	1.804	1.849	1.896	1.943
23	1.158	1.187	1.216	1.247	1.278	1.310	1.344	1.378	1.413	1.449	1.485	1.523	1.562	1.601	1.642	1.683	1.725	1.769	1.813	1.858	1.903	1.950	1.998
23½	1.204	1.233	1.263	1.294	1.326	1.359	1.392	1.427	1.462	1.499	1.536	1.574	1.613	1.653	1.694	1.736	1.779	1.822	1.867	1.912	1.958	2.006	2.054
24	1.251	1.280	1.311	1.342	1.374	1.408	1.442	1.477	1.513	1.549	1.587	1.626	1.665	1.706	1.747	1.789	1.833	1.877	1.922	1.968	2.014	2.062	2.111
24½	1.299	1.329	1.359	1.391	1.424	1.458	1.492	1.528	1.564	1.601	1.639	1.679	1.719	1.759	1.801	1.844	1.888	1.932	1.978	2.024	2.071	2.119	2.168
25	1.347	1.378	1.409	1.441	1.474	1.509	1.544	1.579	1.616	1.654	1.693	1.732	1.773	1.814	1.856	1.899	1.943	1.988	2.034	2.081	2.129	2.178	2.227

FORMULA: $\frac{D^2+d^2+Dd}{144} \times 0.2618 = (D^2+d^2+Dd) \times 0.001818$

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FUEL AND POWER CONSUMPTION CONTROL.

By A. M. Lockett.

It would be well to preface these suggestions with some remarks bearing upon the general proposition of plant operation.

The objects and purposes of the American Wood-Preservers' Association are, as I understand them, to further the interests of its members by increasing the use of treated materials and enabling the members to meet the demand at a minimum cost.

To accomplish this purpose most effectively the members of the Association should fully realize the value of cooperation, not only in publicity work intended to increase the use of treated material, but in devising ways of improving the quality and reducing the cost of such materials, since quality and first cost are the most potent factors in increasing the demand for these materials.

It is manifest that if treated timber could be purchased at a mere nominal advance over the cost of untreated timber practically all work would be constructed of treated materials, and in line with this method of reasoning, while it is not possible to reduce the price of treated materials to a mere nominal advance over the price of untreated materials, it follows that the nearer these prices come together the greater will be the consumption.

To accomplish the best results plant managers should frankly and freely interchange information so that the best practice in each stage of operation can be generally adopted.

At first sight such a suggestion may strike some members unfavorably, because an individual who has succeeded in reducing his costs below his competitors, at some stage of the process may not feel inclined to give his competitors the benefit of his experience, but this individual would do well to remember that while he may have an edge on his competitors in one or two details the chances are very much against his having anything on the combined brains of the Association, and he will, no doubt, gain much more than he will lose by subscribing to the policy suggested.

It goes without saying that the ideal condition for the wood-preserving industry as a whole would be reached when every plant engaged in this work will have corrected all its shortcomings and brought its equipment and its manner of operation up to the maximum of efficiency so that there will be no difference in costs in the various plants except those due to location with respect to fuel, raw materials and the market; and if along with this the members of the Association will have reached that stage of business education which causes a man to adhere to the principle of selling no goods below the point where a fair profit is obtained the practice of naming prices below the proper figures in

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any specific case would automatically disappear without the need of any unlawful agreements.

It has been only in recent years that the most progressive manufacturers have learned the way to arrive at their true costs of production. This has been brought about largely by the interchange of information between members of trade associations, and the more freely the interchange is exercised the more quickly are results obtained.

Time was when these associations simply got together and agreed upon selling prices and since this could be done there was no great incentive to improvement in processes nor the reduction in cost; but now that agreements as to selling prices are unlawful these associations strive to acquaint their members with the true methods for arriving at their costs under the belief that a clear knowledge of costs will stabelize selling prices since all successful business men in any particular line will endeavor to obtain about the same margin of profit.

The writer has never operated a wood-preserving plant, or had access to the books of any plant for a period of several years, but is inclined to believe that very few, if any, of the members of this Association have a sufficiently accurate knowledge of their costs to enable them to determine readily what they should add to their prices to meet some special requirement in the specifications calling for prolonged steaming, a greater period for maintaining the vacuum, or some other change in the process which does in fact add to the cost.

The purpose of these preliminary remarks is to explain the importance of accurate records of the fuel consumption of the plant, not only for the purpose of reducing the costs, but of enabling the actual cost to be arrived at accurately.

In adopting systems of plant records it is very easy for one to become so enthused that he may saddle himself with so many rules, regulations and records that the benefits are more than offset by the expense of carrying out his ideas, but a little common sense mixed with the proposition will cause him to find some middle ground which will enable him to accomplish his purpose without undue expense or annoyance.

The practical way for an individual plant operator to reach the position of highest efficiency is:

1. To ascertain exactly what results he is getting.
2. After learning what his results are, to correct all those things which appear to need correction.
3. To get the benefit of the experience of his fellow members of the Association.
4. After obtaining all available information from his his associates, to make further improvements in his plant which may be suggested by the information so obtained.

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5. Adopt a system of plant records which will enable him to discover promptly any falling off in the results which may be due to improper handling of his plant.

It would seem that this Association could well afford to employ one or more expert engineers who would make periodical visits to all of the plants belonging to the Association for the purpose of making tests and investigations based upon which improvments in methods may be made.

The first duty of these engineers should be to make careful and accurate tests of each plant as now operated, establishing the existing facts with reference to the efficiency of the boilers, the quantity of steam consumed by the entire plant for 24 hours, the quantity of steam consumed during each step of the process and the quantity of steam consumed by each steam-using machine when operating at its normal and usual rate.

The next step would be to have the engineer make the necessary recommendations for the changes which should be made in the plant to bring it up to the proper standard.

After having done this work at each of the plants in the Association he should proceed to test again all of those plants which had followed his recommendations and make further suggestions if the experience gained by him in other plants will suggest any to him.

After the plant has been put in what he would regard as first-class condition, a careful and accurate test should be made with a complete log describing the details of the operations and re-establishing the steam consumption of the various machines.

This last test can then be regarded as a standard which the plant operators should endeavor to live up to.

The engineer should devise record forms, and these records should be religiously kept up by the operatives of the plant. All records used by the various plants being uniform so that comparisons can be readily made.

When one stops to consider the value of the information which a competent expert would obtain by these numerous tests and investigations it would seem that every plant operator would welcome the proposed plan.

The exact form of these records should be designed by your engineers after acquiring the intimate knowledge which they would gain from their experience, but I would suggest the following as a basis for these records:

A separate log sheet should be provided for each apparatus involved in the consumption of fuel. The sheet should be attached to a board and hung at some convenient point so that the man operating the apparatus can make the proper entries.

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The boiler room log should be written up every hour, and should record the steam pressure, the temperature of the feed water, the temperature of the flue gases, the temperature of the atmosphere; the reading of the boiler-feed-water meter and weight of coal delivered to the boiler room floor.

Preferably the log should begin at the beginning of the day watch so that the results obtained by the two watches can be compared and a spirit of competition between the firemen aroused. The coal supply should be under lock and key and at the beginning of each watch the quantity of coal estimated to be required for that watch should be weighed out and deposited in bunkers convenient to the boiler. If any coal remains in the bunker at the end of the watch it should either be weighed or its weight estimated and credit noted on the log; and if any coal above the estimated required quantity is needed the proper notice of that fact should be taken.

It is characteristic of firemen, as it is of all men, to use sparingly anything the use of which is charged to them and also to endeavor to make an allowance for a certain purpose to fulfil that purpose.

Where boiler experts have guarantees to meet, it is customary for them to deal out to the fireman the quantity of coal in a unit of time which the boiler may be allowed to use and come up to its guarantee. The human peculiarity just named is thereby capitalized.

This method of handling coal does not involve any great amount of trouble nor expense, but even if it does involve some additional expense it will be found that the saving in fuel far more than offsets that expense.

The log of the vacuum pump should show the time the pump is started, the time it stopped, the average revolutions per minute, the temperature of the water supply to the condenser, the temperature of the condenser overflow, and should also show 10-minute readings indicating the degree of vacuum until the vacuum is down to the required point; the purpose being to ascertain how long it requires to lower the pressure.

There should be a log also for the pump supplying water to the condenser, if such a pump is used. This log should show the time started, the time stopped and the average revolutions per minute.

There should be logs also of similar character for the oil pumps and in addition to the information called for above these pumps should give the pressure against which they are operating and there should be a statement telling what character of work the pumps were doing.

Similar records should be kept of the hoisting engines, the cranes, the electric light engines and any other machines using steam; the

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log in each case being written up by the man who operates the machine. At the end of the day these logs should be turned into the office together with the charts from all recording instruments and written up on one sheet upon which the records from the various parts of the plants will also be entered so that the superintendent will have a complete and comprehensive understanding of exactly what took place in his plant for the previous 24 hours.

The proper study of these records would bring to light most valuable information and would enable the plant operator to detect any increase in costs and apply the necessary remedy promptly.

Any plant superintendent who carries out these suggestions is being asked to do no more than is done in every well regulated and successful manufacturing establishment, and if all operators of wood-preserving plants would adopt the systematic methods that have been proven to be absolutely necessary in the large industries of the country, the reductions in the price to the consumer would make the use of treated material much more general and the net profits to the wood-preservers would be even greater than they are at present.

This work, of course, can be greatly simplified by the general use of recording instruments and revolution counters.

It is recommended by the General Committee that:

1. The expansion table for creosote be adopted.
2. The table for determining cubical contents of poles and piles be adopted.

For next year's work, it is recommended:

a. In connection with the table for cubical contents of poles and piles, this or some other Committee compile information on tapers.

b. That not exceeding three definite subjects be selected from the classification given for next year's work of the Committee.

c. That the Committee be larger.

A. L. KUEHN, *Chairman*
GEO. M. HUNT
C. W. LANE
A. M. LOCKETT
FRANK MCARDLE
AUGUST MEYER

MR. A. L. KUEHN: Mr. Chairman, I move you that the following be adopted as recommended practice: *The standard temperature at which creosote shall be measured is to be 100° F.*

THE PRESIDENT: Is there a second to the motion?

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MR. C. E. GOSLINE: I second the motion.

THE PRESIDENT: You have heard the motion. All those in favor signify by saying "aye"; contrary, "no." The motion is carried.

MR. A. L. KUEHN: Mr. Chairman, I move the adoption as standard the table for expansion of creosote, given on page 242. In making this motion I would like to offer this discussion. This table, you will notice, requires division, and I think that table represents the common practice. It has been suggested that it is a little easier to do multiplication, and that the reciprocals of this table be also given, or given instead of this. I would like to add to that motion that this table, as well as the reciprocal table, which will require multiplication instead of division, be published in the MANUAL OF RECOMMENDED PRACTICE.

THE PRESIDENT: Is there a second?

MR. C. H. EASTWICK: I second the motion.

THE PRESIDENT: All those in favor of the motion say "aye"; opposed "no." The motion is carried.

MR. M. K. TRUMBULL: That raises an important question which might lead to confusion in the use of the table. For instance, the class of men at the plants who ordinarily use these tables might turn to the wrong table and multiply rather than divide. I think the question should be submitted to the Association as to whether, in its opinion, the use of this table should be confined to one or the other basis, either for division or multiplication, and publish but one. I have found in my own experience that we got better results by using the table of reciprocals. I prepared such a table. The men who use it feel more at home with multiplication than long division. This is largely a personal question with the man who is performing the detail work.

MR. A. L. KUEHN: I might say that I realize the importance of Mr. Trumbull's point in publishing two tables. This table has been adopted as a standard by at least one, and I think two other associations, that are making reports on this question. Therefore, if the second will consent, I will withdraw the latter part of my motion and ask that this one be published only. Then you have the information. It is a very simple matter for any concern that believes their men can do better with multiplication to just make up a table of reciprocals. They have then accepted the coefficient of expansion. That is the main feature in this table.

THE PRESIDENT: Are there any objections to accepting Mr. Kuehn's suggestion as he has just now made it? If not, it will be considered that the suggestion has been adopted.

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MR. A. L. KUEHN: I move that the table entitled, Volume of Piles and Poles, as given on page 249 be adopted as recommended practice.

MR. J. H. WATERMAN: I second the motion.

THE PRESIDENT: Any remarks? All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

Are there any further remarks? Are there any motions as to what shall be done with the remainder of the report?

MR. J. H. WATERMAN: Mr. Chairman, if agreeable to the Committee, I move you it be accepted as information.

MR. F. J. ANGIER: I second the motion.

THE PRESIDENT: Any remarks?

MR. J. C. WILLIAMS: Mr. President, just as a matter of cross-reference, I will point out that in Mr. Lockett's part of the paper, on page 250, second paragraph from the bottom, is a paragraph about commercial conditions. I previously made some remarks about that which were published on page 306 in the 1915 PROCEEDINGS. Anyone reading Mr. Lockett's paper might be interested in looking up what I said at that time.

MR. V. H. ROEHRICH: Mr. President, I was interested to note that nothing was said in that report about testing the coal. I found in connection with the work of testing for the city of St. Paul that it is worth while to watch the heat units or B. T. U. of the coal, using a calorimeter.

THE PRESIDENT: Any further remarks? If not, all those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

We will now have the report of Committee No. 1 on Preservatives. I will ask the Secretary to read the names.

SECRETARY ANGIER: Mr. E. B. Fulks, Chairman, Mr. S. F. Acree, Mr. S. R. Church, Mr. C. N. Forrest, Mr. W. H. Fulweiler, Mr. A. L. Kammerer, Mr. A. E. Larkin, Mr. O. C. Steinmayer and Mr. C. M. Taylor.

MR. E. B. FULKS: Mr. President and Members of the Association: You have in your hands the report of the Committee on Preservatives, but before we begin the consideration of it I want to say a little in the direction of calling the attention of the members of the Association individually to some feelings I have in connection with the work of this Committee.

The mere reading of this report will not convey to you any adequate idea of the immense amount of work that really has been done

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by individual members of this Committee. I myself have a very high appreciation of it and a very deep feeling of gratitude toward members of the Committee for the way in which they have worked on this Committee, and for the amount of work they have done, but even beyond that, and, as I consider, of more importance, is the spirit with which this Committee has worked this year. It is a little hard for me to put clearly just how I do feel about it.

Personally, I have had a feeling that the members of this Committee when acting as members of this Committee really have been self-sacrificing, that is, they have approached the work of the Committee as members of this Committee, and not as individuals with axes of their own to grind. I feel that they really have made a conscientious effort to divest themselves of their personal interest in this matter, and that they have tried to work toward the end of preparing a report which would present something constructive, and which would tend toward the advancement of this Association and toward the wood-preserving industry as a whole. I felt that it was due the members of the Committee that this be brought to the attention of the Association, because I felt quite sure they would not appreciate it just from a mere reading of the report.

The individual members have done a great deal of work, detail work of one sort or another, laboratory, office and otherwise, all through the year on this thing, and I believe the Association will agree with me in saying that they have presented a set of specifications for various things which are far in advance of any specifications of a similar nature heretofore presented to this or any other association. These specifications, even though they are not perfect, afford, the Committee feels, a most excellent basis upon which future constructive work and work tending toward perfect specifications can be based, and if these specifications are adopted, future committees will have a starting point which is solid, and something upon which they can work and improve and thus arrive at a point which is highly desirable.

Now, as to the report as a whole. In preparing the report under the instructions of the Executive Committee, the work naturally fell into four classifications, that is, the compiling and bringing together in one convenient form all the specifications bearing on the subject heretofore adopted by this or any other association, the preparation of specifications for coal-tar preservatives; the preparation of specifications for zinc-chloride preservatives; and the presentation of all information available concerning the use of water-gas-tar as a preservative. On this basis the work was divided among four sub-committees, each having one of those subjects in charge.

To begin with the last, the work of Sub-Committee "D" in connection with the water-gas-tar preservative, there is no question but

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that this Committee has presented a great deal of information on this subject, and they have presented this in concrete and detailed form, in a manner which heretofore has never been done. This matter has been discussed, of course, at length for years before, but there has never before been presented a written, detailed description or any compilation of information about this material. This Sub-Committee I know personally has spent an immense amount of time collecting this information. They have presented here a few photographs. As a matter of fact, they presented a very much larger number of photographs than this, but for practical reasons and reasons of expense, the greater portion of them had to be eliminated from the printed report. This Committee did visit any number of streets, I do not know how many, in various cities, and presented what I consider a very valuable piece of information concerning this matter. The Sub-Committee on the compilation of the work heretofore done by other associations, of course required a great deal of work, which was more or less of an office nature, you might say, a compilation nature, but it did require a great deal of time, and they have presented this in a form which will make that information readily available to any of you who in the future may have occasion to use it. The Sub-Committee on Zinc Chloride carried on a great deal of correspondence and investigation, and presented a specification for zinc chloride. In addition to this it had one problem upon which it spent a great deal of time and work, and which unfortunately it has not been able to solve as yet, that is in arriving at a satisfactory method for the sampling of zinc chloride. The Committee has had to leave that for future investigation. There seems to be something in connection with that which is rather difficult to get at.

Now as to the other Committee on Preservatives derived from Coal Tar, this Sub-Committee approached this work with a good deal of hesitancy. Of course, it realizes that this has been the rock upon which the thing has gone to pieces in the past. After a great deal of thought and discussion it decided not to follow the lines heretofore followed by committees in attempting to write these specifications, namely, that of trying to write a single specification which would cover the two general classes of this material, that is the straight distillate oil and the so-called mixed oil, but to write the best specification it could possibly devise for each one of these classes of oils, that is a specification for distillate oil and a specification for mixed oil. Under the instructions of the Executive Committee this Committee on Preservatives was to prepare specifications for these materials, both for ties and timber, and for wood blocks. This necessitated writing these two classes of specifications; in other words, it makes four specifica-

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tions which the Committee is presenting, two for distillate and two for mixed oil; or putting it the other way around, two for ties and timber and two for paving blocks.

The Committee did a great deal of work of an analytical nature, that is I mean of a laboratory nature. It based its work on specifications heretofore adopted by other associations, and on common practice, but it tried to strengthen those specifications in such a way that any person using the specifications presented at this time, desiring to purchase a distillate oil could take this specification and apply it to the material he has bought and be sure that he got the material that he is trying to buy, and the same thing in connection with a mixed oil. If he wants to buy a so-called coal-tar-creosote solution for ties and timber containing 20% of coal tar, he can use this specification, apply all these tests that have been provided, and rest assured that he is getting what he is trying to buy, that is a material which contains approximately 80% of distillate oil. Of course, the Committee does not claim that these specifications will hold that to an exact 80%. It is impossible in the knowledge that the Committee has gained so far to get any test that will hold it down that close, but the Committee holds that these will protect that reasonably. In other words, by the use of these specifications the Committee feels that any buyer using these specifications or any particular one, will be more amply protected than he ever has been by any specifications heretofore used, that the outgrowth of any one of these specifications will ultimately be a specification that will be a thorough protection.

Except again to reiterate my appreciation of the spirit in which the Committee has worked and for the great amount of work it has done, I feel there is nothing further to say. You have the report in your hands. Unfortunately, the Appendix containing the data on which this work is based could not be gotten out in time to be distributed earlier. However, I must say now that this Appendix only contains a very minute part of the work this Committee really did do. The Committee has just selected examples to prove its points, but you must not think for a moment that the work of the Committee is based on these figures entirely. It perhaps had from ten to twenty times this amount of figures which the Committee used itself. There are a number of mistakes of a minor nature in the report, largely typographical, which it is not necessary to bring up, except as occasionally they are essential, and they will be mentioned at the proper time.

The conclusions of the Committee in the printing of this pamphlet, have been divided by some of the other material, that is, the conclusions begin on page 55 and conclude on page 65. That does not mean that there are twelve pages of conclusions, but it means that some ten pages intervene from the printing of the first conclusion to the printing of

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the last. I take it now that it is in order to proceed with the report. The Committee recommends for adoption in the MANUAL certain things, and recommends for adoption as standards and for the MANUAL certain other things by clauses. I take it these will be acted on one at a time.

The first recommendation of the Committee is for insertion in the MANUAL the definition of tar, as presented by Sub-Committee A on page 280. This definition of tar is one adopted by this Association some years ago, and the Sub-Committee finds no reason to offer any changes in it, and recommends it for adoption. I move, Mr. Chairman, the adoption of that clause.

THE PRESIDENT: Any second to the motion?

MR. A. L. KUEHN: I second the motion.

MR. F. D. MATTOS: Mr. President, in regard to the specification on page 280 covering zinc——

THE PRESIDENT: Mr. Mattos, may I ask you as these different recommendations are presented that you confine your discussions to that particular subject? If you want to talk about zinc, that will come a little later on; if you will just wait and make your remarks on that, when that question comes up.

THE DELEGATES: Question, question.

THE PRESIDENT: If there is no discussion, all those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: The next is a definition of creosote, which takes the same points as the other. It was adopted at the same time. I move the adoption. That is on page 280.

MR. H. M. ROLLINS: I second the motion.

THE PRESIDENT: You have heard the motion. Any remarks? This motion is on the definition of creosote. All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: No. 3, the Committee recommends for insertion in the MANUAL the method of analysis for zinc chloride as presented by Sub-Committee "A" on page 280. This method of analysis is one adopted by the Association some years ago and has been printed once or twice in the PROCEEDINGS. I move the adoption of that.

MR. A. L. KUEHN: I second the motion.

THE PRESIDENT: Any remarks?

MR. L. C. DREFAHL: Mr. Chairman, there is a slight error in the method as outlined here. I believe the one given here is not

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exactly the method which was outlined in the PROCEEDINGS of 1912. There seems to be only a slight difference, but nevertheless it is not exactly the same as 1912.

MR. E. B. FULKS: You will pardon me, Mr. Drefahl. I wish to say that Mr. Drefahl appeared before the Committee and called attention to this. I forgot it. Evidently this was adopted in 1912 and printed in the PROCEEDINGS, and then was printed in 1913 or 1915 or some other time, and in the reprint it was not printed exactly as the previous times, and this one has been copied from the reprint which accounts for the error. I have forgotten what the error is. Mr. Drefahl called that to the attention of the Sub-Committee, and it agreed to take charge of the matter. The one finally printed will be the one that was printed and adopted in 1913. Am I correct in that, Mr. Drefahl?

MR. L. C. DREFAHL: 1912.

THE PRESIDENT: Any further remarks on the adoption of this method of analysis of zinc chloride?

THE MEMBERS: Question, question.

THE PRESIDENT: All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: That includes all the material that has heretofore been adopted by the Association, which the Sub-Committee feels justified in recommending for insertion in the MANUAL. At one time previously the Association did adopt a standard thermometer for coal-tar creosote distillations. It so happens that various other associations have adopted thermometers for essentially the same purpose, but there have been slight differences in the description of each one of these, which are minute and do not affect the general results, but there are differences, and they have resulted in the manufacturers having to make four kinds of these thermometers for the one purpose. Representatives of this Committee have met with representatives of other committees, and have come to an agreement to use the same standard for this thermometer. This standard will come up later on simply as a part of the method of making creosote analysis. At this point the Sub-Committee "A" recommends that the specification for standard thermometer heretofore adopted be repealed. The specification is presented by Sub-Committee "A" on page 282. I move the recommendation of the Sub-Committee be adopted and the standard theremometer be repealed.

MR. A. L. KAMMERER: I second the motion.

THE PRESIDENT: Any remarks? All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

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MR. E. B. FULKS: That concludes all the recommendations concerning that part. The Committee now recommends for adoption as standards and for insertion in the MANUAL the following: Zinc chloride as proposed by Sub-Committee "C" on page 326. I move the adoption of this.

MR. A. L. KAMMERER: I second the motion.

MR. F. D. MATTOS: It seems to me that unless we specify a minimum percentage in this matter of zinc chloride, that we will be lowering our standards and letting down the bars and by so doing encourage the production of a very poor quality of zinc chloride. I feel that it is absolutely essential to place a limit on this matter and unless we do, our companies may be obliged to pay transportation charges on a lot of impurities which have no preservative value and the presence of which may be objectionable. This matter should be freely discussed.

MR. J. H. WATERMAN: Mr. President, our specifications which Mr. Angier had more to do with probably than any other one, read "not less than 94% soluble chloride of zinc." Now I would like to have Mr. Angier explain to these people what he thinks of this recommendation, and I would like to have the Committee explain to us why it changed it.

MR. E. B. FULKS: Pardon me. My understanding of this is that the Committee has not made any change in regard to that point. It has simply taken the specification previously adopted by the American Railway Engineering Association and has made some slight changes, namely, about the iron, and introduced something about its being bought on the basis of 100%, but my understanding is that there never has been any such requirement for a minimum content of zinc chloride in any specification adopted by an association. It is true those things exist in some contracts.

MR. F. J. ANGIER: Mr. President, with reference to the specification Mr. Waterman refers to, we have also on the Baltimore & Ohio the same specification that he has on the Burlington. That gives a limit of soluble zinc chloride of 94%. It seems to me there should be a limit set. Otherwise, as Mr. Mattos has said, they can have 75% soluble zinc chloride, or any other amount. There is another point I might mention, and that is the iron content. We state in our specifications that it may be a trace, or 0.022. When we made our last contract for zinc chloride I took the matter up with the company to see if it would make a reduction in price if we changed that to read 0.25, and the company replied that it would make no change, that it would cost just as much. I believe 0.25 is the amount specified by the American Railway Engineering Association. Our Committee now has doubled

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that and made it 0.50. I do not know what effect that will have on the treatment of timber, but if it will bring about a reduction in the price of zinc, and has no injurious effect on timber, I think it is a pretty good thing.

MR. E. B. FULKS: Mr. Chairman, if I may suggest, Mr. Taylor has considered all these points, and I think can clarify the situation a little. Mr. Taylor, will you make a statement about this?

MR. C. M. TAYLOR: In reference to the proposition of limiting the available zinc chloride to 94% it is true that it has appeared in most contracts up to date, and it seems reasonable and rational that there should be a limit to the per cent. of available zinc chloride in any fused salt of zinc chloride. The impurities of zinc chloride are some basic zinc chloride, which is not available for preservative purposes, some water and such other salts as ammonium chloride and magnesium chloride, which, to our minds at present, have no bad effect on the zinc chloride. The question of limiting it to 94% is proposed by one of the large producers, and it has made quite a point of it to the Committee.

As a member of the Sub-Committee, I do not feel that we have given all the producers a chance to be heard on the subject, and in view of the fact that we in our report are not specifying any minimum limit, it leaves the question open for discussion both by consumers and by the producers, so that if next year, we do want to put a limit of 90 or 94 or some other percentage, the producers and consumers can produce some reasons for placing such a limit. We do not know what is going to take place in the zinc market, and I think that the contracts already placed by the members of the Association, specifying 94% available, will protect them for the ensuing year.

In the meanwhile, I would suggest that the producers submit to the Committee on Preservatives some reasons why the percentage should be 94% other than that the last 15 years it has been 94%, and it has become a habit. I strongly recommend on the part of the Committee that the specifications as given in this report be adopted this year. It is in line with good practice, but if some economic reason should arise during the ensuing year requiring that the limit shall be made 94%, let them produce the facts.

MR. A. E. LARKIN: Mr. President, the specification that has governed the manufacture and distribution of zinc chloride in the fused state for a number of years has made 94% the low limit of purity.

It has been explained to the Committee that 2% of impurities will creep into this material and that there is usually 2% of water that cannot be avoided. This accounts for 98% of the material furnished.

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Manufacturers agree to account for 98% of the product furnished, 94% of which is to be pure zinc chloride. To lower the standard would simply invite adulteration of the material and this certainly should be against the principles of the American Wood-Preservers' Association. Is it any more difficult to furnish fused zinc chloride 94% pure now than it has been years prior to this time?

MR. J. H. WATERMAN: I say from a common sense standpoint when this convention adopts something as standard and this Committee, or the Chairman of the Committee, admits when he introduces the Committee to the convention that they do not know how to sample it, that we ought to at least refer it back to the Committee for another year. Mr. Taylor, who spoke in favor of this, says that the contracts are all made for a year, so we cannot hurt anybody. Why do we want to put something in the MANUAL if we cannot tell the fellow who gets it or receives it how he is going to sample it? From my standpoint, I say the common sense standpoint, not a technical standpoint, it is absurd. Therefore, I move to amend the motion. Is there a motion before the house?

THE PRESIDENT: There is.

MR. J. H. WATERMAN: That we refer this back to the Committee until it can tell us how to sample zinc chloride.

MR. A. E. LARKIN: I second the motion.

THE PRESIDENT: Gentlemen, the amendment is out of order in view of the fact that it is contrary to the motion.

MR. J. H. WATERMAN: I move to substitute my motion instead of the original.

THE PRESIDENT: Is there a second to that?

MR. A. E. LARKIN: I second the motion.

MR. E. B. FULKS: Mr. Chairman, I would like to say a few words. This whole situation was precipitated rather abruptly in the meeting yesterday of the Committee. The Sub-Committee had presented this specification which it had drafted as the result of its information. Yesterday representatives of manufacturers appeared before the Committee with these suggestions concerning this specification. The Sub-Committee felt that perhaps those suggestions were quite proper and correct. It does not question those at all, but they came so suddenly it had no time to investigate them and since they only came from one source, the Committee felt a bit of hesitancy about coming right in and proposing them as a specification. It felt that the specification, as it had proposed it, is at least as good as any specification now a standard of any other association, and that it does not

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preclude anybody when they want to buy zinc chloride from putting in some clause relating to minimum content of zinc chloride. But any clause relating to the minimum content of zinc chloride necessarily, of course, involves a method of sampling which, as I said before, there seems to be something exceedingly difficult about making.

The Committee had up personally and by correspondence with all the manufacturers of zinc chloride this question of how they were going to sample the drums. The manufacturers could give them no light on the subject and they could not arrive at anything themselves, so if the manufacturers do not know how to sample it and the Committee does not know how, why certainly it is something that has got to be worked out. That is only a side light, so far as this particular phase is concerned about this minimum content. It is perfectly obvious that is a reasonable thing and should be included in the specification, but the Sub-Committee feels that it is not justified in setting that minimum right now with the information it has. Personally, I would hate to see the whole thing thrown back for further work, just on that account. I think it would be much better if the specification proposed, although slightly imperfect, be adopted as the standard at the present, and later, at the proper time, it can be referred to the future committee for investigation and correction. I think it would be a mistake to throw the whole thing out as it stands.

MR. S. R. CHURCH: Heretofore there has been no satisfactory device for sampling tank cars of creosote oil for the purpose of determining the percentage of water in the oil. For the past two years I have served on a special committee to design a sampler for that purpose. The work has just been completed. I mention this now in order to point out the fact that the lack of a suitable sampling apparatus has not stopped people from putting a clause in every contract, limiting the percentage of water allowed in the oil. They did not refrain from writing specifications merely because there was no perfectly satisfactory method of sampling.

MR. A. E. LARKIN: Mr. Chairman, it is apparent from the remarks just made by the chairman of this Committee, Mr. Fulks, that we are not ready to adopt the specifications submitted by this Committee as a standard. The only argument Mr. Fulks has made why we should accept and approve this specification is that it is a step in the right direction and that to adopt this standard now for publication in the MANUAL would save considerable delay. The fact that he admits there is a doubt in the minds of the Committee about the matter is the very reason why it is a mistake to adopt any standard at this time. His statement is proof conclusive that the matter has not been considered carefully enough to warrant even the members of this Committee

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in recommending the adoption of this specification as it stands, for publication in the MANUAL.

MR. C. M. TAYLOR: Mr. Chairman, the report as submitted by the Committee is fit and ready to go into the MANUAL. We can at any time amend or add to that specification. I am almost certain there will not be any change by any subsequent convention of the part that is now ready for the MANUAL. There probably will be put in at some future time a minimum limit of available zinc chloride. We started out first with a fractionation of creosote oil and have gradually improved the analysis of creosote oil. That has not altered at all the original specifications. The same thing exists in connection with zinc chloride. This basic clause, we would like to have that adopted as proper, and if the manufacturers can prove to us that later we should have a minimum, and, as Mr. Waterman says, it is common sense that we should have a minimum, let us prove that that minimum protects us and does not increase the cost. It is very possible that the refining of zinc chloride from 90 to 94% increases the cost. There have been quantities of zinc chloride on the market which ran between 90 and 94%.

MR. J. H. WATERMAN: From 85 to 90%.

MR. C. M. TAYLOR: Let us not do it this year. Let us make them prove it. They have only come forward so far and said we want 94. The part that is now before the convention is the basis for zinc-chloride specifications. If we want to revise afterwards and put a minimum on, all right.

MR. J. H. WATERMAN: Mr. Chairman, everybody that has spoken on this subject admits that we ought to have a minimum, and I hope this convention will support my motion.

MR. A. L. KAMMERER: I want to call the attention of the Association to the fact that the essential part of this specification is that it specifies that the material shall be furnished on the basis of the actual 100% zinc chloride present, which I think is establishing a great deal, and it is not lowering the standards. That is the essential feature of these specifications as submitted, and the question of what the minimum amount shall be is secondary to that and can be established when there is more data at hand. This question was not considered by the Sub-Committee, because of the fact it was not brought up until yesterday afternoon, and the Sub-Committee hardly felt that it could at the last minute fix an arbitrary figure of 94% when possibly 92% or 90% might be considerably cheaper; in fact, out of all proportions to the advantage of the small percentage gained in purity. For that reason the Sub-Committee has been unwilling to decide on any arbitrary figure of purity. As I said before, the essential part of the specification is that the zinc chloride shall be furnished on the basis of the percentage of pure zinc chloride present.

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As far as establishing any method of sampling, the Committee felt that there was considerable difference of opinion on that, and in lieu of being able to come to any definite conclusion as to a standard, that would have to be left to the individual buyer, or his chemist as to how he would sample that material. I think the Association would make a great mistake if it did not adopt this specification as a starting point.

MR. GEO. E. REX: For the information of the Association I would like to ask Mr. Drefahl if we wait until we can recommend a satisfactory sampling method of fused zinc before we adopt a zinc-chloride specification how long will it be before we have a specification?

MR. L. C. DREFAHL: I did not quite understand you, Mr. Rex.

MR. GEO. E. REX: If we wait to adopt a specification of zinc chloride until the Association has a satisfactory method of sampling, how long will it be before we have a specification for zinc chloride?

MR. L. C. DREFAHL: That would be rather hard to say, Mr. Rex, but I do not think the question of sampling is an insurmountable question. I think if the manufacturers and the consumers got together on that point in a reasonably short period of time, there should be some solution to that particular problem, after which it is only a question of a short period of time before a specification could be arrived at using the sampling method as a basis. I do not think there are any difficulties connected up with it at all.

MR. GEO. E. REX: You do not think there is any difficulty connected with sampling?

MR. L. C. DREFAHL: The sampling is a difficult matter. It has to be done a certain way. It is going to take some outlay at the manufacturers' plants. Whether or not all the small plants would be able to prepare for it and make the necessary preparation on account of the cost, is a matter that would have to be investigated.

MR. GEO. E. REX: We have been using zinc chloride for a good many years, and so far as I know nobody has ever presented any satisfactory method of sampling it. My feeling is if we wait for that method of sampling, until that method is perfected, before we adopt a zinc-chloride specification, there will be several more gray hairs on our heads before we get that specification for zinc chloride. I feel that this portion of the Committee's report is all right and should be adopted (applause).

MR. A. E. LARKIN: Mr. Chairman, I think it would be very easy for Mr. Kammerer's remarks to be misunderstood. He explained that the vital point in this question is not the amount of zinc in the chloride salt but the purity of the salt itself. This would imply that if the zinc were pure but amounted to only 75% of the contents of the

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drum it would be acceptable to the purchaser. If we were to receive drums of chloride of zinc which contained only 75% of the pure zinc chloride and 25% of adulteration, we should have great difficulty in using it. I am sure, for instance, that none of the railroad operators would allow treating to proceed with 25% of adulteration or impurities in the solution. With the specification standing as it does now, with no minimum, we are just as liable to get 75% chloride of zinc as we are 94%, necessitating adjustments on freight, extra handling, etc. This specification is certainly not ready for adoption.

MR. WALTER BUEHLER: Mr. President, as Mr. Kammerer has stated, there are basic principles recommended by this Committee that are of more importance than the question under discussion. It seems to me the question under discussion is something that lies between the purchaser and the seller. I believe that this Association should endorse the recommendation of the Committee.

DR. H. VON SCHRENK: I simply want to say a word in commendation of the specification. I think a good many of the objections raised to the specifications are more or less irrelevant. The basic principles involved in this specification are fundamental. I do not think anybody will question that. I do not see personally any reason why this Association should not endorse a distinct advance in the art of writing specifications simply because there are certain factors that have not yet been developed sufficiently to make it possible to adopt it as a whole.

Referring to some of the remarks made here as to the small impurity, as stated by one of the speakers, the small percentage of magnesium salt or ammonium salt will not bother particularly. There are a great many cases where it has been used with a very much higher percentage of impurity than any we have here. I personally feel very strongly there ought to be some limit, and I think everybody else does. We have here in this specification for the first time a fundamental statement of facts, and there is nothing wrong in the specification. Why should this Association throw it out simply because it is not absolutely perfect? As Mr. Rex says, if we wait until we get all these factors we may have to wait a long time. I would very strongly urge the Association to adopt the specification.

MR. A. E. LARKIN: Mr. President——

THE PRESIDENT: Just a moment, Mr. Larkin, please. It is regrettable that our time for our meeting is limited. We will have to divide our time as well as we can. I feel that our time for this particular discussion is up. We will allow a few minutes, however, for any remarks that are particularly pertinent to this subject before putting the question. We will give a few moments to the discussion.

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MR. A. E. LARKIN: Mr. President, if we adopt this specification as it stands it is a plain invitation for some one to start up in the zinc-chloride business who is not capable of developing a 94% pure product, but might be able to manufacture something 75% pure. If we eliminate the minimum required and let the bars down, we will not have the opportunity to work with the high-grade material we are now getting.

MR. L. B. MOSES: Mr. President, I see no reason at all why Mr. Waterman's position should not be carried out just as well after the adoption of this Committee's report as before it. If the Committee's report is adopted with instructions to the Committee on Preservatives to proceed along the lines Mr. Drefahl has suggested and bring in next year, if possible, a method of sampling, we will not have gone backward and we can go right ahead, forward, and just because he is a good fellow I am going to ask him to withdraw his substitute.

MR. J. H. WATERMAN: All right.

MR. E. B. FULKS: Gentlemen, I am glad to hear that the one point I had in mind is the point agreed on. When I started the discussion on this report the idea was that we were trying to establish a starting point. If we adopt this thing we have got a starting point. If we do not we are in the air the same as we always have been. I am awfully glad he has withdrawn his substitute.

MR. J. H. WATERMAN: My friend referred to me as a good fellow. I want to be. I want to endorse this Committee and its work. However, I cannot see their point. They all argue that they are not even sure, the President, Mr. Taylor and everybody else. Now, I have no objection to accepting this, but I have an objection to putting it in the MANUAL. I have no objection to it being printed in the PROCEEDINGS, none whatever, but I object to its being put in the MANUAL, and that is my substitute motion.

THE PRESIDENT: Gentlemen, there are two motions before the house. One is that we adopt as recommended practice this specification for zinc chloride. There is also a substitute motion that we refer the specification back to the Committee. If the substitute carries, that ends the matter. If it is voted down then we will vote on the original motion. I will now put the substitute. All those in favor signify it by saying "aye"; opposed, signify it by saying "no." The substitute is lost.

I will now put the original motion, which is that we adopt this specification as recommended practice. All those in favor signify it by saying "aye"; opposed, "no." There is no doubt that it is carried.

MR. E. B. FULKS: Mr. President, the next recommendation of the Committee is for adoption as standard and insertion in the MANUAL,

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The specification for creosote for ties and structural timber as proposed by Sub-Committee "B." I move the adoption of this recommendation.

MR. A. L. KAMMERER: I second the motion.

THE PRESIDENT: Any remarks? All those in favor of the motion signify it by saying "aye"——

MR. A. E. LARKIN: Mr. President, referring to the recommendation by the Committee, this recommendation for creosote oil for ties and structural timber is a step in the right direction and should be adopted. The Committee, however, does not go far enough. It should answer the question as to what the American Wood-Preservers' Association recommends as the best practice with reference to the right kind of oil to be used for certain work.

The specification that has been most frequently quoted and referred to is the American Railway Engineering Association No. 1 specification for creosote oil, which the members of that Association recommend as the best oil for this class of work. Why should we not at the same time we submit this specification state that it is the one recommended for use by the Association as being the oil that will give the best results in the treatment of timber, piling and ties?

The Committee has submitted a creosote oil for ties and structural timber and a creosote-coal-tar solution for ties and structural timber with no recommendation as to which is the better oil. The Committee has made no qualification in the use of the two materials, and they are apparently on a parity with each other; that is, they might be so considered by the layman or the engineer not having had much experience in the treatment of wood with preservatives.

THE PRESIDENT: Gentlemen, I think all realize that we have a pretty big problem before us. It is one that is far reaching and if we get out on the branches I am quite sure we will not have time to take action upon everything that might come up here at this meeting. The Executive Committee gave certain instructions to this Committee, and it has prepared its report in accordance with these instructions. I think we will have to bar out at this time all discussion or presentation of new matter which does not bear directly upon this Committee's report, and which covers subjects which were not requested from this Committee by the Executive Committee.

As I recall the instructions of the Executive Committee we asked this Committee to prepare specifications for preservatives that are now in common use for treating different materials such as paving blocks, ties and structural timber, but did not ask for any recommendations as to the comparative value of these different preservatives. Therefore, a comparison of values is not a part of this report, and we will not take it up for consideration at this time.

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MR. WM. A. FISHER: If it is in order, Mr. President, I move as an amendment to the motion before the house that the Committee be instructed to present next year additional oil specifications similar to the existing A. R. E. A. specification for Grades 2 and 3.

THE PRESIDENT: Mr. Fisher, in order that we may keep clearly in mind the subjects under discussion I will ask you not to present any paper or discussion at this time which does not bear directly upon the specifications which are now under discussion. After this report has been disposed of, if you then wish to suggest that the Committee be instructed to do certain work next year, it will then be in order.

MR. WM. A. FISHER: If I have an opportunity for that?

THE PRESIDENT: You will have an opportunity for that a little later, if you will allow me to leave your motion until that time comes.

MR. WM. A. FISHER: I will withdraw my motion.

MR. E. B. FULKS: Just a remark, and to prevent it coming up again, I want to say, as indicated by this footnote, the Committee did not intentionally ignore those other two specifications that the American Railway Engineering Association has, and did not consider that they were withholding any of that at all, but it is only humanly possible to do a certain amount of work, and the Committee did all that it could, and felt that in arriving at this specification it has got, it did all the work it could. The Committee really did not have time to consider all those other things with the detail it would want to consider them. Therefore, the Committee considered by making this reference that is in this footnote, to the fact that it presented this type specification, that anyone desiring to make a contract based on lower limits, could easily adjust this specification to meet that circumstance. Of course, the Committee has in mind that in the future that situation will be met, but I just want to say that it was not ignored or left out intentionally, or anything of that sort.

MR. M. K. TRUMBULL: Mr. President, we are discussing the specification on page 307?

THE PRESIDENT: Yes, the specification that has been recommended for a distillate oil for treating ties and timber. If you will confine your remarks to the specification, you will be in order.

MR. M. K. TRUMBULL: Has the Committee any objection to insert in lieu of the symbol, when stating what the specific gravity shall be, the words "compared with water at"? This suggestion is in the interest of laymen.

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MR. E. B. FULKS: The Committee appreciates that point, and has no objection to that. It is very willing to make such corrections as that.

MR. A. E. LARKIN: Mr. President, it is true we are considering the adoption of certain specifications, but I take exception to your statement to the Association to the effect that we must confine ourselves to the instructions given by the Executive Committee to this Committee in the consideration of the adoption of standards, and that the Executive Committee instructions do not happen to provide for the placing of the specifications according to their relative merits. My request should be considered, because you cannot differentiate between the recommendations regarding a specification and the recommendation regarding its use, or at least its proper place relative to its importance as a preservative.

DR. H. VON SCHRENK: I rise to a point of order.

THE PRESIDENT: State your point.

DR. H. VON SCHRENK: This organization in the past has suffered greatly from a great deal of wasted time and energy in discussing problems before the Association. If there is any question as to the ruling the President made, I suggest that an appeal be taken sustaining the President's ruling.

THE PRESIDENT: Gentlemen, I assure you that I do not want to take any arbitrary stand on anything, but the ruling I made was, in my judgment, for the best interests of the Association, and made with the idea that our work may not be obstructed, but that we might be able to accomplish the most during this session that would be in the best interests of our Association. After this report has been disposed of, if the Association wishes to take some time for the discussion of other things which have been suggested by this Committee's report you will then have an opportunity to present such motions or suggestions as you like, and time will be given for their consideration, but unless I am overruled we will not allow new material to be injected into this Committee's report.

THE MEMBERS: Question! Question!

THE PRESIDENT: All those in favor of the question signify by saying "aye"; those opposed, "no." The motion is carried.

MR. E. B. FULKS: Mr. Chairman, the next recommendation of the Committee is No. 3, the adoption as standard and for insertion in the MANUAL of the specification for creosote-coal-tar solution for ties and structural timber, as proposed by Sub-Committee "B" on page 307. Mr. Trumbull, your criticism will apply to all these. I move the adoption.

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MR. GEO. E. REX: I second the motion.

THE PRESIDENT: Any remarks?

THE MEMBERS: Question! Question!

MR. A. E. LARKIN: Mr. President, the criticism on this creosote-coal-tar solution for ties and structural timber is the fact that it is not as definite as it should be. It has apparently been surrounded with as many tests as the Committee knows to protect the final mixture. It occurs to me that the way to absolutely protect the purchaser of creosoted materials, and creosote oil especially, is for the purchaser to know in some way what kind of material, what kind of creosote and what kind of tar enters into the mixture. In the interest of clearness a specification for not only the resulting mixture, but a specification for the creosote oil and a specification for the tar should be submitted.

THE PRESIDENT: Any further remarks?

THE MEMBERS: Question! Question!

THE PRESIDENT: All those in favor of the motion signify it by saying "aye"; those opposed, "no." The motion is carried.

MR. E. B. FULKS: Mr. President, the next recommendation is No. 4. The Committee recommends for adoption as standard and insertion in the MANUAL specification for coal-tar oil for paving blocks, as proposed by Sub-Committee "B" on page 308. I move the adoption of the specification.

MR. A. L. KUEHN: I second the motion.

MR. A. E. LARKIN: Mr. Chairman, I do not like to burden you, but I want to get before you the criticism that I really think should be taken into consideration. Here again I have the same criticism with reference to this coal-tar oil for paving blocks. I think there is no doubt that the Committee should state the difference between these two materials. I know it is not covered by the instructions of the Executive Committee, but nevertheless it is due the members of the Association, and it is due the industry.

The same criticism, except to a greater degree, applies to the specification of the mixture and of the two materials that enter into it. The Committee says that it is not necessary to specify the creosote and the coal tar that enter into the mixture, and yet it states in this particular specification that there shall be 65% of creosote and 35% of coal tar. Now, that is of course subject to manipulation, and by manipulation I mean perfectly honest manipulation by the manufacturer. He will submit materials that will fill the specification, and he can submit any number of materials. He can use a light creosote and a heavy tar, or a light tar and a heavy creosote, and the purchaser is at sea.

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The latter does not know whether or not he has received 65% of creosote. It is absolutely impossible to determine.

MR. S. R. CHURCH: In reply to the last speaker, I wish to say on behalf of the Committee that the intent of the definition which requires in so many words that the oil shall be at least 65% distillate, was that no one could "honestly manipulate" the specification. We hold that if a manufacturer, under that specification, adds more than 35% of filtered or refined coal-gas or coke-oven tar, he does not put it in honestly. In regard to the statement that low boiling creosote can be mixed with a heavy tar to make a mixture complying with the specification, we deny that. The specification for the finished product controls the distilling range of the distillate oil used. Naturally, the distilling points of the distillate oil itself will be somewhat lower than the distilling range of the finished product.

THE MEMBERS: Question! Question!

THE PRESIDENT: Are you ready for the question? All those in favor of the motion please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: The next is No. 5. The Committee recommends for adoption as standard and insertion in the MANUAL the specification for distillate oil for paving blocks as proposed by Sub-Committee "B" on page 308. I move the adoption of this recommendation.

THE PRESIDENT: Is there a second?

MR. H. S. LOUD: I second the motion.

MR. A. E. LARKIN: Mr. President, referring to the distillate oil for paving blocks, this specification is a step in the right direction. However, this Association should recognize the higher-boiling oils and the heavier-gravity pure-distillate oils should have very careful consideration. The Committee has been asked to recommend a heavier high-boiling oil than is covered by its specification, but it has not done so.

There are many references showing that the high-boiling oils are desirable and most effective, that they should be used, and have given the very best results on record. Read the following from "Lunge," page 355:

> But the successful timber is always found to contain the heavier and less-volatile portion of the oil, the greater bulk of which is composed of substances distilling over 300° C.

These high-boiling oils should be included in the MANUAL as the highest standard available and toward which we should work. It is essential to have high standards. Dr. von Schrenk has made a number of references to high standards, which should be maintained. One example is found on page 202 of the 1912 PROCEEDINGS of the American Wood-Preservers' Association, which reads:

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> We must have a high standard toward which we can work. We get millions of gallons of creosote every year which does fill that specification. That there is oil which is available, which does not do so, is no reason for abandoning the standard. In view of perfectly incontrovertible facts as to the rate with which the poorer oils leave creosoted timber, ... the high standard is the only safe course.

He was referring to the American Railway Engineering Association Grade 1 oil.

THE MEMBERS: Question! Question!

THE PRESIDENT: All those in favor of the motion will signify it by saying "aye"; contrary, "no." The motion is carried.

MR. C. H. TEESDALE: Mr. President, when the American Railway Engineering Association adopted the specification for the creosote-tar solution for ties and structural timber——

THE PRESIDENT: Is it on these specifications that you are talking?

MR. C. H. TEESDALE: Yes, sir. They adopted and placed in their Manual a paragraph qualifying the creosote and tar solution, and I would like to move that this paragraph, which reads as follows, be included in our MANUAL at the proper place:

> This specification is submitted for the guidance of those desiring to use the coal tar addition to creosote for ties only, which practice is firmly established and widely followed. The creosote-coal tar solution is not recommended as equal to creosote in preservative quality, and should be used for ties only when the available supply of creosote is inadequate.

THE PRESIDENT: Mr. Teesdale, that has to do again, as I understand it, with value or relative values.

MR. C. H. TEESDALE: Yes, sir.

THE PRESIDENT: That question is not before the house at this time.

MR. C. H. TEESDALE: Can that be taken up at the proper time?

THE PRESIDENT: After this Committee has presented its report, if we have time to go into the value of these oils, and it is the desire of the Association to go into the value of these oils, that can be taken up.

MR. E. B. FULKS: That concludes the recommended specifications, but the Committee now recommends a number of methods of analysis. Before we start these, there are a number of errors in the printing of these, and so on, which Mr. Church will call your attention to before we start. They apply throughout the whole thing.

MR. S. R. CHURCH: I will not call attention to minor typographical errors at present. Attention should, however, be called to the fact that the drawings of apparatus form an essential part of the

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standard methods. There were a number of pieces of apparatus referred to in the report of Sub-Committee "B," which were also referred to in the report of Sub-Committee "A." In order to save expense, the Secretary quite properly omitted the duplication of these drawings. Unfortunately, we did not make the matter perfectly clear, or the drawings would have been omitted from the reference methods and included in the standard methods, whereas in some cases the reverse of this was done. This will, no doubt, be corrected in the PROCEEDINGS. In looking for an illustration of apparatus referred to in any one of the standard methods, if it does not appear in the proper place, it can be found under the same figure number in the report of Sub-Committee "A."

Just a word in reference to these methods of analysis. They are all part of the general endeavor toward standardization of methods in our own Association and other associations. The distilling test for creosote oil was first standardized by the American Railway Engineering Association. The method was enlarged and refined in details by the American Society for Testing Materials, and now has been taken into our standards. None of the methods are new, excepting the coke test, which is taken from the report of the National Electric Light Association of 1911, and the consistency test of the residue.

MR. E. B. FULKS: Gentlemen, the balance of this has to do with the adoption of methods of analysis. The Committee recommends a number of methods. The first one is a method for the determination of the amount of water as proposed by Sub-Committee "B" on page 309. I move the adoption of this recommendation.

MR. R. V. LOOK: I second the motion.

THE PRESIDENT: Any remarks? All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: The next method presented here is with reference to the determination of the amount of insoluble in benzol, as proposed by Sub-Committee "B" on page 310. This relates to so-called free carbon in oil. I move the adoption of this recommendation.

MR. H. M. ROLLINS: I second the motion.

THE PRESIDENT: All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: The next relates to the method for the determination of specific gravity as proposed by Sub-Committee "B" on page 312. I move the adoption of this recommendation.

MR. R. V. LOOK: I second the motion.

THE PRESIDENT: All those in favor of this motion signify it by saying "aye"; contrary, "no." The motion is carried.

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MR. E. B. FULKS: The next relates to the Distillation Test as proposed by Sub-Committee "B" on page 313. The Committee recommends the adoption of the distillation test as here proposed. This test includes the adoption of the standard thermometer, which I spoke of a while ago. I move the adoption of this recommendation.

MR. E. W. BRIGHT: I second the motion.

THE PRESIDENT: All those in favor please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: Next the Committee recommends the determination of the specific gravity of fractions, as proposed by Sub-Committee "B" on page 312. I move the adoption of this recommendation.

MR. H. S. LOUD: I second the motion.

THE PRESIDENT: All those in favor please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: The Committee recommends the adoption of the float-test, as proposed by Sub-Committee "B" on page 318. I move the adoption of this recommendation.

MR. H. S. LOUD: I second the motion.

THE PRESIDENT: All those in favor of this motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: The Committee recommends the method for the determination of the coke residue as proposed by Sub-Committee "B" on page 320. I move the adoption of this recommendation.

MR. H. S. LOUD: I second the motion.

THE PRESIDENT: All those in favor of this motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. S. R. CHURCH: Mr. Chairman, it seems proper to state at this point that the Secretary had a communication from the Director of the Forest Products Laboratory, enclosing a paper by Mr. Bateman, commenting on the oil specifications proposed by a joint committee of several societies interested, referring to the conference meeting in Brooklyn last September, and it was said this paper would be of especial interest.

MR. S. R. CHURCH: There is no especial reason why this paper, which is somewhat lengthy, should be read at the present time. A part of this was presented to the Committee by Mr. Bateman and considered by the Committee in its deliberations, and it was of considerable assistance. If the completed work had been received in time, undoubtedly we should have used some of these data in our appendix. As

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Mr. Weiss says in his letter, it substantiates the work of the Committee in general, and there are some suggestions made that may be helpful to the Committee in its future work, and the whole matter will undoubtedly appear in the PROCEEDINGS.

There is also a letter from Mr. E. R. Dutton, Assistant Engineer of Minneapolis, commenting on the coal-tar paving-oil specification. This letter was written by Mr. Dutton before he had been advised by our Committee of the slight change in the specific gravity of the fractions, which was made subsequent to the adoption of the specification, by the American Society of Municipal Improvements. Mr. Dutton, however, by this time, as well as the other committee of the Civil Engineers, has been officially notified of this change.

REPORT OF COMMITTEE ON PRESERVATIVES.

To the Members of the American Wood-Preservers' Association:

Committee No. 1 on Preservatives presents herewith a report of its activities for 1916, and its recommendations to the Association.

The appointment of this Committee was not announced until April 4, 1916, and its complete personnel was not definitely known until April 22. Thus the Committee was very late in getting its work started and, as a consequence, it has not been able to complete its work and the report thereof in as much detail and at so early a date as it had desired.

The instructions of the Executive Committee for the work of this Committee were received by the Chairman on April 17, and a meeting of the Committee was arranged for the earliest date possible, May 15. At this meeting, which was attended by the entire membership, the work to be done was discussed in detail and was apportioned among four sub-committees, as follows:

SUB-COMMITTEE A: S. F. Acree, Chairman
O. C. Steinmayer

SUB-COMMITTEE B: S. R. Church, Chairman
A. E. Larkin
A. L. Kammerer

SUB-COMMITTEE C: A. L. Kammerer, Chairman
C. M. Taylor
S. F. Acree

SUB-COMMITTEE D: W. H. Fulweiler, Chairman
C. N. Forrest

These sub-committees did a great deal of work during the summer, by means of correspondence and of meetings, and their various reports are made a part of this report in their entirety.

Another meeting of the Committee was held in Cleveland on Nov. 14, at which all the members were present, except Mr. Larkin and Mr. Steinmayer. (Mr. Forrest was represented by J. C. Williams.)

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The chairmen of the various sub-committees presented their reports, which were discussed in detail, and, after a few minor changes, were unanimously approved.

In addition, there was a verbal report from the joint committee, representing this and other associations, for the purpose of developing a standard method for sampling creosote in tank cars. This report was to the effect that the Committee has developed some of the instruments which seemed most promising in its work last year. Several of these samplers have been distributed among treating plants where they are being used under the observation of the Committee. It was thought best to make these tests in winter as well as summer, consequently a report cannot be made until next year.

The reports of the sub-committees, as adopted by the full Committee follow:

REPORT OF SUB-COMMITTEE A.

Your Sub-Committee was assigned the following:

1. Collect and compile all specifications and definitions concerning preservatives which had been approved by the Association. Recommend such revision as may be necessary, and present for insertion in the MANUAL.

2. Present for information:

   a. Specifications for preservatives which have been adopted by other associations or organizations.

   b. Methods of tests and analyses which have been adopted by other associations or organizations, or which may be in large use commercially.

Your Sub-Committee has taken upon itself to amplify the first instruction to include methods of analyses and tests which have been adopted by the Association. It finds that Committee No. 1, 1914, has already accomplished practically the entire work, which was printed in the PROCEEDINGS for 1915. However, the findings of that Committee have been verified by a careful search by this Sub-Committee through all the PROCEEDINGS of the Association. Under item 1 it finds (1) that this Association has no standard specifications for preservatives of any kind. Several such specifications have been presented to the Association, but none has been formally adopted; (2) the following definitions have been approved by the Association, and the Committee sees no reason for change. It, therefore, recommends them for inclusion in the MANUAL.

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Tar.

Tar, in the scientific sense, may be properly defined as a non-aqueous liquid product obtained in the destructive distillation of complex organic matter. Tars vary greatly in character, both chemically and physically. They may be roughly divided into three classes:

CLASS A. *Tars consisting principally of compounds belonging to the aromatic series, and containing well-defined amounts of phenoloids.*

CLASS B. *Tars consisting principally of compounds belonging to the aromatic series, but lacking phenoloids.*

CLASS C. *Tars consisting principally of compounds belonging to the aliphatic series.*

Creosote.

Creosote, in the scientific sense, may be properly defined as any and all distillate oils boiling between 200° and 400° C., which are obtained by distillation from tars consisting principally of compounds belonging to the aromatic series, and containing well-defined amounts of phenoloids.

3. The following method of analysis for zinc chloride was adopted by the Association in 1912. The Committee sees no reason to change this and, therefore, presents it for insertion in the MANUAL.

METHOD OF ANALYSIS OF ZINC CHLORIDE.

Insoluble (Basic Zinc Chloride).

Ten to 14 grams of the sample (fused or granulated), or an equivalent quantity of solution, are weighed from stoppered weighing bottles into a 600 c.c. Jena beaker. Four hundred cubic centimeters of cold water are added and stirred until the material is completely in solution. The basic zinc chloride is allowed to settle over night. Solution is filtered through a weighed filter paper (12½ c.m.). Filtrate is received in a graduated calibrated measuring flask, capacity 1000 c.c. The beaker is policemanned, and the insoluble matter on the filter paper is washed thoroughly till the filtrate measures 1 litre. Filter paper containing the insoluble matter is dried over night in a bath heated to 212° F., cooled, and weighed in between clipped watch glasses. Increase in weight is calculated to insoluble (basic) matter.

In the line of suggestion, it is necessary to previously wash and dry the 12½ c.m. paper used for filtering the insoluble matter, in order that this paper gets analogous treatment to that used in actual analysis. Owing to the fact that the hydrated oxychloride of zinc is slightly soluble in water, it becomes necessary to make the method empirical, and in order to get concordance between various operators it is necessary to pass all the water necessary to make up the liter through the filter paper upon which the precipitate is retained.

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Estimation of Zinc.

The filtrate from the insoluble matter referred to previously is made up to the mark and shaken. Three aliquot portions of 100 c.c. each are taken with a 100 c.c. pipette, which has been accurately calibrated volumetrically against the flask used for receiving the filtrate. To each of the aliquot portions in the beaker, 15 grams of ammonium chloride are added and 5 c.c. of strong hydrochloric acid, and diluted to a volume of 350 c.c. with hot water. This is allowed to stand on the steam plate until nearly boiling (180° F.), and then titrated with slow addition and vigorous stirring with potassium ferrocyanide solution, using uranium acetate as an external indicator.

This method is not for use where the manganese chloride content exceeds 0.3%. In such cases the method is varied as follows: To the 100 c.c. aliquot portions 1 c.c. of hydrogen peroxide (2½ to 3%) and 10 c.c. of 1 to 1 ammonia are added. Allow this to stand on the steam bath until settled. Filter off the manganese, wash the beaker and paper twice with hot wash water. Dissolve the precipitate in the smallest amount of 1 to 1 hydrochloric acid in the original beaker, and heat until all is dissolved; the volume of the solution should then be about 20 c.c. Reprecipitate the manganese with 1 c.c. hydrogen peroxide and 10 c.c. of ammonia, boil, filter, and wash several times with hot water. Add the filtrate to the filtrate obtained from the first separation. To the combined filtrates add 15 c.c. hydrochloric acid and just neutralize with concentrated ammonia, then add 5 c.c. hydrochloric acid in excess. Add 25 c.c. saturated hydrogen sulphide water to remove any traces of hydrogen peroxide, dilute to 325 c.c., heat to 180° F. and titrate as in the previous case.

Estimation of Iron and Alumina.

Ten grams of the sample are weighed into a beaker and dissolved in 100 c.c. of water. Dilute hydrochloric acid is added in sufficient quantity to dissolve all the basic zinc chloride. Add bromine water in slight excess and boil off the excess. A weak solution of sodium carbonate is added until a slight permanent precipitate of zinc carbonate is obtained. Add three drops of glacial acetic acid and 2 grams of sodium acetate, and boil. Filter and wash. Redissolve the precipitate in the original beaker with hot 1 to 1 hydrochloric acid. Reprecipitate the iron and alumina with a slight excess of ammonia, filter, and wash free from chloride. Ignite in a platinum crucible, and weigh as Fe_2O_3 *and* Al_2O_3.

Solution Used in Determination of Zinc.

STANDARD FERROCYANIDE SOLUTION. *Weigh out 43.25 grams of c.p. potassium ferrocyanide and 14 grams of c.p. crystallized sodium sulphite,*

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dissolve in water, and make up to 1000 c.c. at room temperature. Shake thoroughly. Standardize against a zinc solution of known concentration, prepared from spelter of known zinc content or from c.p. zinc oxide previously ignited. One cubic centimeter of this solution will be equal to approximately 0.01 gram of zinc. Keep the solution in a dark bottle. Shake the bottle thoroughly and standardize the solution each time it is used.

INDICATOR. *Dissolve 4.4 grams of c.p. uranium acetate (free from sodium) in 100 c.c. of hot water, and add 2 c.c. glacial acetic acid. For a spot test for external indicator work 0.05 c.c. on a paraffine plate gives the most satisfactory results.*

WASH WATER. *In all zinc analyses it will be found sufficient to wash with hot water containing 10 grams of ammonium chloride and 10 c.c. of concentrated ammonia to the liter.*

HYDROGEN PEROXIDE. *This reagent is very perishable. It can be tested for its strength by titrating with potassium permanganate.*

HYDROGEN SULPHIDE SOLUTION. *The usual saturated solution commonly used in the laboratory is employed.*

The Association has not adopted any standard methods of analysis for any other preservative. It has, however, adopted a standard size of thermometer to be used in whatever distillation test is proposed for creosote and other liquid preservatives.

The Committee is advised that Sub-Committee B, in presenting methods of analysis for creosote, will include a specification for a thermometer. This specification is one which a conference of representatives of a number of associations has selected for general adoption, and is not essentially different from the present standard of the Association. The Committee, therefore, recommends the repeal of the present specification which is as follows:

SPECIFICATION FOR STANDARD THERMOMETER.

The thermometer shall be of glass, well annealed, and shall undergo no serious change at the zero point when heated to 400° C. The space above the mercury column shall be filled with gas, either carbon dioxide or nitrogen, and the thermometer shall have an expansion chamber at the top.

The scale shall read from 0° to 400° C. in 1° C. graduations, which shall be etched on the stem.

The tip of the thermometer shall carry a ring for the purpose of attaching tags. The thermometer shall have the following dimensions:

Total length, 375 m.m.; tolerance, 10 m.m.
Bulb length, 14 m.m.; tolerance, 1 m.m.
Distance from 0 to bottom of bulb, 30 m.m.; tolerance, 4 m.m.
Scale length from 0° to 400° C., 295 m.m.; tolerance, 5 m.m.
Diameter of stem, 7 m.m.; tolerance, 1 m.m.
Diameter of bulb, 6 m.m.; tolerance, 1 m.m.

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When standardized, the accuracy of such standardization should be as follows:

Up to 200° C. to the nearest 0.5° C.
200 to 300° C. to the nearest 1.0° C.
300 to 360° C. to the nearest 1.5° C.

Your Sub-Committee presents for information the following specifications for preservatives which have been adopted by other associations and societies having committees on preservative subjects.

Zinc Chloride.

Specification taken from the American Railway Engineering Association's Manual, 1915:

> The zinc chloride used shall be as free from impurities of any kind as is practicable, being slightly basic, free from free acid, and containing not more than 0.25% iron.

No other association has adopted a specification for zinc chloride.

Preservative Oils.

Specifications for creosote taken from the A. R. E. A. Manual, 1915:

Standard Specifications for Creosote Oil.

The oil used shall be the best obtainable grade of coal-tar creosote; that is, it shall be a pure product obtained from coal-gas tar or coke-oven tar and shall be free from any tar, including coal-gas tar and coke-oven tar, oil or residue obtained from petroleum or any other source; it shall be completely liquid at 38° C., and shall be free from suspended matter; the specific gravity of the oil at 38° C. shall be at least 1.03. When distilled by the common method; that is, using an 8-oz. retort, asbestos covered, with standard thermometer, bulb ½ in. above the surface of the oil—the creosote, calculated on the basis of dry oil, shall give no distillate below 200° C., not more than 5% below 210° C., not more than 25% below 235° C., and the residue above 355° C., if it exceeds 5% in quantity, shall be soft. The oil shall not contain more than 3% water.

(Note: In addition to the above standard specification, the two following grades can be used in cases where the higher grade oil cannot be procured. It should be understood that where it is necessary to purchase grades No. 2 and No. 3 consideration should be given to the use of a greater quantity of creosote oil per cubic foot).

Specification for No. 2 Grade Creosote Oil.

The oil used shall be the best obtainable grade of coal-tar creosote; that is, it shall be a pure product obtained from coal-gas tar or coke-oven tar and shall be free from any tar, including coal-gas tar and coke-oven tar, oil or residue obtained from petroleum or any other source; it shall be completely liquid at 38° C., and shall be free from suspended matter; the specific gravity of the oil at 38° C. shall be at least 1.03. When distilled by the common method, that is, using an 8-oz. retort, asbestos covered,

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with standard thermometer, bulb ½ in. above the surface of the oil—the creosote, calculated on the basis of the dry oil, shall not give more than 8% distillate below 210° C., not more than 35% below 235° C., and the residue above 355° C., if it exceeds 5% in quantity, shall be soft. The oil shall not contain more than 3% water.

Specification for No. 3 Grade Creosote Oil.

The oil shall be the best obtainable grade of coal-tar creosote; that is, it shall be a pure product obtained from coal-gas tar or coke-oven tar, and shall be free from any tar, including coal-gas tar and coke-oven tar, oil or residue obtained from petroleum or any other source; it shall be completely liquid at 38° C., and shall be free from suspended matter; the specific gravity of the oil at 38° C. shall be at least 1.025. When distilled by the common method, that is, using an 8-oz. retort, asbestos covered, with standard thermometer, bulb ½ in. above the surface of the oil—the creosote, calculated on the basis of dry oil, shall give not more than 10% distillate below 210° C., not more than 40% below 235° C., and the residue above 355° C., if it exceeds 5% in quantity, shall be soft. The oil shall not contain more than 3% water.

Specification for Creosote-Coal-Tar Solution.

This specification is submitted for the guidance of those desiring to use the coal-tar addition to creosote, which practice is firmly established and widely followed. The creosote-coal-tar solution is not recommended as equal to creosote in preservative qualities, and should be used only when the available supply of creosote is inadequate.

1. The oil shall be a pure coal-tar product, consisting only of coal-tar distillates and oils obtained by the filtration of coal-tar. It shall contain no admixture of crude tar.

2. Water shall not exceed 2%.

3. The specific gravity at 38° C. shall not be less than 1.03 nor more than 1.10.

4. Matter insoluble in hot extraction with benzol shall not exceed 2%.

5. The specific viscosity (Engler) at 82.3° C. (180° F.) shall be not more than 1.170 for 200 c.c. No variation above this standard shall be allowed. The term "specific viscosity" in this case shall mean the number of seconds for water at 20° C., given in the official certificate for the viscosimeter used, divided into the number of seconds for the creosote-tar solution at 82.3° C.

6. On distillation by the standard method of the A. R. E. A. it shall yield the following fractions based on dry oil:

Not more than 1% at 170° C.
Not more than 5% at 210° C.
Not more than 30% at 235° C.
The residue at 355° C. shall not exceed 26%.

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The Use of Coal Tar in Creosote.

Wherever possible only Grade 1 coal-tar creosote should be used, and under no circumstances should coal-tar be added to creosote of this grade.

SPECIFICATIONS FOR CREOSOTED WOOD BLOCK OIL ADOPTED BY THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS, 1916.

Kind.

The preservative to be used may be either a coal-tar paving oil "A" or a coal-tar distillate oil "B" as herein specified.

"A" Coal-Tar Paving Oil.

The oil shall be a coal-tar product of which at least 65% shall be a distillate of coal-gas tar or coke-oven tar, and the remainder shall be refined or filtered coal-gas tar or coke-oven tar. It shall comply with the following requirements:

(1). It shall not contain more than 3% of water.

(2). It shall not contain more than 3% matter insoluble in benzol.

(3). The specific gravity of the oil at 38° C. shall not be less than 1.07 nor more than 1.12.

(4). The distillates based on water free oil shall be within the following limits:

Up to 210° C. not more than 5%
Up to 235° C. not more than 25%

The residue above 355° C., if it exceeds 35%, shall have a float test of not more than 80 sec. at 70° C.

(5). The specific gravity of the fraction between 235° and 315° shall not be less than 1.02 at 38°/15.5° C.

The specific gravity of the fraction between 315° and 355° shall not be less than 1.09 at 38°/15.5° C.

(6). The oil shall not yield more than 10% coke residue.

"B" Coal-Tar Distillate Oil.

The oil shall be a distillate of coal-gas tar or coke-oven tar, and shall comply with the following requirements:

(1). It shall not contain more than 3% of water.

(2). It shall not contain more than 0.5% of matter insoluble in benzol.

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(3). The specific gravity of the oil at 38° C. shall be not less than 1.06.

(4). The distillates based on water-free oil shall be within the following limits:

Up to 210° C. not more than 5%
Up to 235° C. not more than 15%

The residue above 355° C., if it exceeds 10%, shall have a float test of not more than 50 sec. at 70° C.

(5). The specific gravity of the fraction between 235° and 315° shall be not less than 1.02 at 38°/15.5° C.

The specific gravity of the fraction between 315° and 355° shall be not less than 1.09 at 38°/15.5° C.

(6). The oil shall yield not more than 2% of coke residue.

Water-Gas Tar.

In view of the fact that some cities are using the water-gas tar, your Committee (Committee on Wood Block Pavements of the American Society of Municipal Improvements) deems it advisable to suggest a specification for their guidance. This specification is the one submitted and agreed to by Mr. C. N. Forrest, Chemist, Barber Asphalt Paving Co., and Mr. W. H. Fulweiler, Chemist, United Gas Improvement Co., and is as follows:

The preservative shall be refined water-gas tar and shall comply with the following requirements:

(1). The specific gravity shall be not less than 1.12 nor more than 1.14 at 38° C., referred to water at the same temperature.

(2). Not more than 2% shall be insoluble by hot extraction with benzol and chloroform.

(3). On distillation, which shall be made as hereinafter described, the distillate based upon water free oil shall be within the following limits:

Up to 210° C., not more than 5%
Up to 235° C., not more than 15%
Up to 315° C., not more than 40%
Up to 355° C., not less than 25%

(4). The specific gravity of the total distillate below 355° C., shall not be less than 1.00 at 38° C., referred to water at the same temperature.

(5). The oil shall not contain more than 2% water, and due allowance shall be made for all water and insoluble foreign matter it may contain, by injecting a corresponding additional quantity into the blocks.

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SPECIFICATIONS FOR PRESERVATIVE OILS, NATIONAL ELECTRIC LIGHT ASSOCIATION (1911).

"A" Specification Covering Coal-Tar Creosote Oil.

The material required under this specification is that commonly known as dead oil of coal tar or coal-tar creosote. More specifically defined it is:

a. A distillate from tar produced as a by-product in the manufacture of coal-gas from bituminous coal by the retort method.

b. A distillate from the tar produced as a by-product in the manufacture of coke from bituminous coal by the byproduct coke-oven process.

c. A distillate obtained from a mixture of the above mentioned tars.

d. A product obtained by mixing distillates from the above mentioned tars.

It is understood that the presence of any hydrocarbons other than the above, either in the original tars or in the distillates therefrom, will, by defeating the purpose of this specification, which is to secure a pure distillate oil from coal-gas or coke-oven tar, be looked upon as an adulteration, which may result in the rejection of the oil. As further defining the material required, the hydrocarbons specifically provided against include the following:

e. Raw or partly distilled tars or petroleum oils of any description whatsoever, such as coal-tar, coke-oven tar, water-gas tar, oil-tar, lignite-tar, blast-furnace tar, producer-tar, wood-tar and crude petroleum.

f. Distillates from any of the above mentioned tars or oils, except distillates from coal-tar and coke-oven tar.

g. Residues from any of the above mentioned tars or oils.

h. Products obtained by filtration of any of the above mentioned tars or oils.

The purchaser of the treated timber, or his representative, shall have the right to take samples of the oil from the oil tanks or from the treating cylinders at the treating plant and to test such samples whenever or wherever desired. The oil may be refused upon satisfactory evidence that it does not conform to the specifications. In the event of a dispute between the purchaser of the treated timber and the firm treating the same the matter shall be referred to a referee mutually agreed upon by a representative of the purchaser and the manufacturer, and the decision of the referee shall be binding and final.

Information as complete as possible shall be furnished to the purchaser upon request as to the origin and history of the oil.

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PHYSICAL AND CHEMICAL CHARACTERISTICS.—The oil required under this specification must, in addition to being of satisfactory origin, possess certain physical and chemical characteristics, which are as follows:

(1). It shall have a specific gravity of at least 1.03 and not than 1.08 at 38° C. If the gravity is taken at a higher temperature a correction of 0.0008 for each degree Centigrade above 38° shall be made.

(2). There shall not be over 1% of residue insoluble in hot benzol.

(3). The original oil shall not contain over 2% of water.

(4). The oil shall be miscible in absolute alcohol volume for volume.

(5). The residue remaining upon sulphonating a portion of the total distillate shall not exceed 1%.

(6). The oil shall contain not more than 8% of tar acids.

(7). When 200 grams of the oil are distilled in accordance with the requirements of the specifications for the analysis of coal-tar dead oil or coal-tar creosote and the results calculated to water-free oil:

a. Not more than 5% of the oil shall distill off up to 205° C.

b. Not more than 35% of oil shall distill off at 235° C.

(Note: The percentage distilling to 245° and 270° C., shall be noted.)

c. Not more than 80% shall distill off at 315° C.

d. The coke residue shall not exceed 2%.

e. The distillate between 205° C. and 235° C. shall deposit naphthalene on cooling to 15° C.

"B" Specification Covering Mixed Oils.

The material required under these specifications is a homogeneous mixture of a distilled product obtained from coal-gas tar or coke-oven tar and generally known as coal-tar dead oil or coal-tar creosote with certain other hydrocarbons. More specifically defined, the added material, which must constitute not more than 40% of the final mixture may consist of:

a. Raw or partly distilled coal-tar, coke-oven tar, water-gas tar, lignite tar, blast-furnace tar, and producer tar.

b. Distillates from any of the above mentioned tars.

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c. Products obtained by filtration of any of the above mentioned tars.

As further defining the material required, it is understood that the presence in the oil of any of the hydrocarbons given below will, by defeating the purpose of this specification, which is to secure a mixed oil containing certain hydrocarbons, be looked upon as an adulteration, and the oil may be rejected. The oils provided against are as follows:

d. Petroleum oil or distillates or of residues therefrom.

e. Water-gas tar containing over 10% paraffine oil.

f. Oil tar containing over 10% paraffine oil.

g. Distillates or residues from water-gas tar or oil tar containing over 10% paraffine oil.

PHYSICAL AND CHEMICAL CHARACTERISTICS.—The oil required under this specification must have the following characteristics:

(1). It shall have a gravity of at least 1.04 and not more than 1.10 at 38° C.

(2). There shall be not over 3% of residue insoluble in hot benzol.

(3). The oil shall contain not over 3% of water.

(4). The residue remaining upon sulphonating a portion of the total distillate shall not exceed 5%.

(5). The oil shall contain not less than 2% nor more than 8% of tar acids.

(6). When 200 grams of the oil are distilled in accordance with the requirements of the specifications, herein referred to, and the results calculated to water-free oil:

a. Not more than 3% of oil shall distill off at 205° C.

b. Not more than 25% of oil shall distill off at 235° C.

(Note: The percentage distilling to 245° C., 270° C., and 360°C., shall be noted.)

c. Not more than 80% shall distill off to 315° C.

d. The residue above 360° C. shall not exceed 35%.

"C" Specification Covering Water-Gas-Tar Creosote Oil.

The material required under this specification is that known as dead oil of water-gas tar or water-gas-tar creosote. More specifically defined, it is:

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a. A distillate from tar produced as a byproduct in the manufacture of carbureted water gas from petroleum oil.

It is understood that the presence of any other hydrocarbon, either in the original tar or the distillate therefrom, will, by defeating the purpose of this specification, which is to secure a pure distilled oil from water-gas tar, be looked upon as an adulteration which may result in the rejection of the oil. As further defining the material required, the hydrocarbons specially provided against include:

b. Raw or partly distilled tar or petroleum oil of any description whatsoever, such as coal tar, coke-oven tar, water-gas tar, oil tar, lignite tar, wood tar, and crude petroleum.

c. Distillates from any of the above tars or oils, except distillates from water-gas tars.

d. Residues from any of the above mentioned tars or oils.

e. Products obtained by filtration of any of the above mentioned tars or oils.

PHYSICAL AND CHEMICAL CHARACTERISTICS.—The oil required under this specification must have the following characteristics:

(1). It shall have a specific gravity of at least 1.03 and not more than 1.08.

(2). There shall be not over 1% of residue insoluble in hot benzol.

(3). The oil shall contain not over 2% of water.

(4). The residue remaining upon sulphonating a portion of the total distillate shall not exceed 5%.

(5). When 200 grams of oil are distilled in accordance with the requirements of the specification of analysis, herein referred to, and the results calculated to water-free oil:

a. Not more than 2% of oil shall distill off at 205° C.

b. Not over 10% of oil shall distill off up to 235° C.

(Note: The percentage distilling to 245° and 270° C. shall be noted.)

c. Not more than 60% shall distill up to 315° C.

d. The coke residue shall not exceed 2%.

Your Sub-Committee presents for information the following methods for analysis of preservatives which have been adopted by other associations and societies having committees on preservative subjects:

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Zinc Chloride.

No methods of analysis for zinc chloride are given by the American Railway Engineering Association, the National Electric Light Association, or the American Society for Testing Materials.

The following method of analysis of zinc in treated timber is taken from the Manual of the A. R. E. A. for 1915:

A. R. E. A. DETERMINATION OF ZINC IN TREATED TIMBER.

Taking Sample.

(1). The tools necessary for taking samples are a cross-cut saw and a 1-in. auger. These should be wiped perfectly clean each time before taking a sample in order to avoid contaminating the samples.

(2). The timbers from which samples are to be taken for analysis should be selected before the charge is loaded and carefully weighed individually. They should be of average size and comparatively free from knots. After treatment they should be weighed and then piled until the dripping has stopped, when the samples may be taken.

(3). For ordinary determinations timbers such as ties should be sawed at two points, viz., 2 ft. from the end and at the center of the tie. Each section should be designated section No. 1 and section No. 2, respectively. In special cases where it may be necessary to cut a tie into several sections the exact distance from the end of each section should be given.

(4). When a large number of ties are to be analyzed it will be sufficient to cut but one section 2 ft. from the end, thereby saving the 6-ft. piece for a narrow gauge tie.

(5). After the sections have been cut, three samples should be taken from each section as follows: No. 1, ½ in. from outside; No 3, at the center of the section; No. 2, halfway between No. 1 and No. 3. The samples are taken by boring a hole 2 ins. deep with a 1-in. bit saving all the borings. Each sample should be properly labelled as tie No. ——, section No. ——, sample No. ——, and a list made showing the location, date, number of run, kind of treatment, and weight of each tie before and after treatment.

Method of Determining Zinc Chloride in Samples.

(6). Three grams of dry borings should be weighed into a 250 c.c. flask, and 3 c.c. of concentrated sulphuric acid added. The flask should be gently heated on a sand bath or hot plate until the wood becomes thoroughly charred. A few drops

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of concentrated nitric acid should then be added. When the brown fumes have disappeared, a few more drops should be added, and the addition continued, a few drops at a time (toward the last the amount should be increased), until the organic matter is all destroyed. When this point is reached, the liquid will remain colorless on further heating. The flask should then be allowed to cool and be diluted with 100 c.c. of water (the water should be added carefully at first).

As a rule, the residue in the flask will be completely dissolved, but if there should be a slight sediment it may be disregarded.

Ammonium hydroxide should be added until distinctly alkaline and allowed to cool. If there is a precipitate of iron hydroxide, or if there has been any undissolved sediment in the flask, it should be filtered; if not, it should be poured into a 400 c.c. beaker and 5 c.c. ammonium sulphide added and allowed to stand over night. It should then be filtered into an 11 c.m. filter paper; washed thoroughly with water containing ammonium sulphide and dried. It should then be incinerated in a porcelain crucible and roasted until the zinc sulphide is converted into zinc oxide.

The weight should be divided by 3 and the result multiplied by 1.674, which will give the number of grams of zinc chloride contained in 1 gram of wood examined, or the number of pounds per pound. To convert this result into pounds of zinc chloride per cubic foot of wood multiply by the weight in pounds of 1 cu. ft. of the wood.

Sampling Wood-Preserving Oils.

The method of sampling from A. R. E. A. Manual, 1915, is as follows:

The sample taken for analysis shall be strictly average of the whole bulk of the oil to be tested. The oil shall be completely liquefied and well mixed before samples are taken. Whenever possible a drip sample of not less than 2 gals. shall be taken, commencing after the oil has started to run freely. When this cannot be done, as for instance in large storage tanks, samples shall be taken from various depths in the tank by means of a tube or bottle, the number of samples depending on local conditions.

For taking samples during the process of treatment, a sample of oil shall be taken from the storage tank about 1 ft. from the bottom of the tank before the cylinder is filled, and, where possible, a sample directly from the cylinder during the process of treatment. For this purpose a thermometer well may be used. The sample to be analyzed shall be thoroughly liquefied by heating until no crystals adhere to a glass stirring rod, and also well shaken,

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after which one-half shall be taken for analysis and the balance reserved for a check test.

Method of sampling taken from the N. E. L. A. Proceedings, 1911 is as follows:

One gallon sample of oil shall be taken for analysis, the manner of collecting the same depending on the nature of storage. The oil must be completely liquid when the sample is taken and it may, therefore, be necessary to heat the tank or other receptacle in which it is contained. The following general rules shall be observed when sampling from:

(a) TANK BOAT.—The sample shall be taken from the pumping system while discharging from the boat into the receiving tank as follows:

A ½-in. cock shall be placed in the line at any convenient point and a continuous stream of oil drawn through this cock during the entire time of emptying the boat. The rate of flow of the stream shall be proportionate to the rate of flow of oil in the pumping line, and it should be such that a gallon sample may be collected for each 10,000 gals. of oil passing through the pipe. The bulk sample thus obtained, which may be caught in a barrel or other suitable receptacle provided for the purpose, shall be thoroughly mixed and shall, if necessary, be heated to bring into solution any material which may have crystallized out. A 1-gal. sample shall be taken from this for analysis.

(b) STORAGE TANKS LESS THAN 20 FT. IN DEPTH.—In sampling from storage tanks of less than 20 ft. in depth a "thief" shall be employed. It shall be made of a length of ½-in. pipe provided at the lower end with a lever-handle cock having an opening of approximately the same size as the interior of the pipe. This pipe being open the thief is lowered slowly into the tank, and when it has touched bottom the cock is closed by means of a chain, wire, or iron rod carried to the top of the pipe. A sufficient number of samples thus procured shall be taken to aggregate 1 gallon.

(c) STORAGE TANKS OVER 20 FT. IN DEPTH.—Samples shall be taken from such tanks through ½-in. cocks placed one above the other and 1 ft. apart on the side of the tank. One gallon of oil shall be withdrawn from each level, and the bulk sample thus obtained shall be thoroughly mixed as in *(a)* and the final sample taken from this.

(d) TANK CARS.—Drip samples shall be taken from tank cars as in *(a)*.

(e) TREATING CYLINDERS.—Samples from treating cylinders shall be taken from the charging and discharging line as in *(a)*.

Tentative method for sampling, A. S. T. M., 1915:

1. Whenever the oil is being loaded or discharged by means of a pump the following method shall be used:

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The pipe-line through which the material is being pumped shall be tapped on the discharge side of the pump, preferably in a rising section of the pipe-line. The sample shall be taken by means of a ½-in. pipe extending halfway to the center of the main pipe and the inlet of the ½-in. pipe shall be turned to face the flow of the liquid. This pipe shall discharge into a barrel or drum of 50 or 100 gals. capacity, and the plug cock regulated so as to secure a continuous uniform stream during the entire pumping of the shipment. The barrel, or preferably the iron drum, should be provided with a small steam coil sufficient to keep the content thoroughly liquid. The temperature shall not exceed 120° F. The contents of the barrel or drum shall be very thoroughly agitated and small samples for testing taken immediately. The amount of the drip sample collected shall be not less than 1 gal. for each 1,000 gals. of material handled, excepting in the case of large boat shipments where a maximum of 100 gals. will suffice.

2. In sampling from storage tanks it is necessary to secure samples from different levels, and where possible this may be done by means of small outlet cocks at regular intervals from the top to the bottom of the storage tank. In such cases about 1 gallon of oil shall be drawn from each outlet cock and thoroughly mixed and a portion taken for testing. The stream from each cock shall always be allowed to flow for sufficient length of time to empty the outlet pipe and nipple before commencing to collect the sample. When tanks have no outlet cock a vessel having a string attached to the cork may be lowered to a measured depth representing a number of different levels in the tank and the cork removed when the vessel has reached the proper level. These samples shall be combined for an average as above.

3. The method of sampling tank car shipments is under investigation by the society.

Determination of Moisture.

Methods suggested by manufacturers of oil:

(a.) When it is not desired to make further examination the apparatus to be used is shown in Figs. 5 and 6. Measure 50 c.c. of coal-tar naphtha or light oil (which must be tested to determine that it is free from water whenever a new supply is received) in a 250 c.c. cylinder. Add 200 c.c. of creosote. Transfer contents of cylinder to copper still and wash the cylinder with 50 to 75 c.c. more of naphtha, adding the washings to the contents of the still. Attach lid and clamp using a paper gasket, and set up apparatus as shown in Fig. 5. Apply heat by means of the ring burner, and distill until the vapor temperature, as indicated by the thermometer, has reached 205° C. The distillate is collected in a separatory funnel, to which 15 to 20 c.c. benzol has been previously added. This effects a clean separation of oil and water. The reading is made after twirling the funnel and allowing to settle for a few minutes. The percentage of water is taken by volume.

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(b.) When it is required for further test the oil is dried by taking about 500 c.c. in the apparatus used for water determination, but without the addition of naphtha. The distillation is carried to 205° C. vapor temperature. Any oil which has distilled over is separated from the water (warming the separatory funnel, if necessary) and returned to the still.

Specific Gravity.

Method taken from the A. R. E. A. Manual, 1915:

In order to determine the specific gravity of any oil simply heat the oil in a water bath until it is completely liquefied. A glass stirring rod dipped into the oil should show no solid particle on the rod when the same is withdrawn from the oil. When completely liquefied it should be stirred thoroughly and the hydrometer cylinder which has been previously warmed filled. Insert a specific gravity hydrometer of good make, taking care that the hydrometer does not touch the sides or bottom of the cylinder when the reading is taken. This reading should preferably be taken when the oil is at 38° C., because at this temperature almost all oils are completely liquid. When contract requirements specify a specific gravity at a different temperautre such gravity is obtained by multiplying 0.0008 by the number of degrees Centigrade, or 0.00044 by the number of degrees Fahrenheit, the oil is found to be above the temperature required by the contract and adding the product to the observed gravity.

Method taken from the A. S. T. M. Proceedings, 1915-16:

(a) HYDROMETER.—The hydrometer shall be of the form and dimensions shown in Fig. 8.

(b) CYLINDER.—The cylinder shall be of the form and dimensions shown in Fig. 9. A standardized hydrometer shall be used. A set of two with ranges 1.00 to 1.08 and 1.07 to 1.15 will suffice. The oil shall be brought to a temperature of 38° C., and the determination shall be made at that temperature unless the oil is not entirely liquid at 38° C.

In case the oil requires to be brought to a higher temperature than 38° C., in order to render it completely liquid, it shall be tested at the lowest temperature at which it is completely fluid and a correction made by adding 0.0008 to the observed specific gravity for each degree Centigrade above 38° C., at which the test is made. This correction factor does not apply with equal accuracy to all oils, but serious error, due to its use, will be avoided if the foregoing precaution is observed with respect to avoiding unnecessarily high temperatures.

Before taking the specific gravity the oil in the cylinder should be stirred thoroughly with a glass rod, and this rod when withdrawn from the oil should show no solid particles at the instant of withdrawal. Care should be

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taken that the hydrometer does not touch the sides or bottom of the cylinder when the reading is taken and that the oil surface is free from froth and bubbles.

Distillation Test.

Test taken from the A. R. E. A. Manual, 1915:

The apparatus for distilling creosote shall consist of a stoppered glass retort similar to that shown in Figs. 10 and 12, having a capacity as nearly as can be obtained of 8 oz. up to bend of the neck when the bottom of the retort and the mouth of the off-take are in the same plane. A nitrogen filled mercury thermometer of good standard make divided into full degree Centigrade shall be used in connection therewith.

In order to insure uniform results for comparative purposes the length of the thermometer bulb shall be ½ in. but in no case shall a thermometer with a long bulb be used. The bulb of the retort and at least 2 ins. of the neck shall be and remain covered with a shield of heavy asbestos paper, shaped as shown in Fig. 12 during the entire process of distillation, so as to prevent heat radiation. Between the bottom of the retort and the flame of the lamp or burner two sheets of wire gauze, each 20-mesh fine and at least 6 ins. square, shall be placed. The flame shall be protected against air currents. An ordinary tin can from which a portion of the bottom and all of the top have been removed placed on a support attached to the burner, as shown in Fig. 12, will answer the purpose.

Before beginning the distillation the retort shall be carefully weighed and exactly 100 grams of oil placed therein, the same being weighed in the retort. The thermometer shall be inserted in the retort with the lower end of the bulb ½ in. from the surface of the oil and the condensing tube attached to the retort by a tight cork joint. The distance between the bulb of the thermometer and the end of the condensing tube shall not be less than 20 ins., nor more than 24 ins., and during the process of distillation the thermometer shall remain in the position in which it was originally placed. The distillate shall be collected in weighed bottles and all fractions determined by weight.

Report shall be made on the following fractions:

0 to 170°
170 to 200°
200 to 210°
210 to 235°
235 to 270°
270 to 315°
315 to 355°
Residue above 355° C.

Reports shall be made on individual fractions. In making such reports it is to be distinctly understood that these fractions do not necessarily refer to individual com-

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pounds. In other words, the fraction between 210 and 235 will not necessarily be all naphthalene, but will probably contain a number of other compounds.

The distillation shall be continuous and should require about 45 minutes. When any measurable quantity of water is present in the oil the distillation shall be stopped, the oil separated from the water and returned to the retort, when the distillation shall be recommended and the previous readings discarded.

In obtaining water-free oil it is desirable to free about 300 to 600 c.c. of the oil by using a large retort and 100 grams of the water-free oil for the final distillation. In the final report as to fractions a correction shall be made of the amount of water remaining so that the report may be made on the basis of dry oil.

Test taken from the N. E. L. A. Proceedings, 1911:

(a) FLASK.—The flask required is a Lunge side-necked distilling flask provided with a trap (Fig. 1) and having a tubular 30 c.m. long placed close to the bulb. The flask must have a capacity of 300 c.c. when filled to a height equal to its maximum diameter.

(b) THERMOMETER.—The thermometer must be of Jena glass and be nitrogen filled, and graduated at intervals of 1 m.m. in singles degrees, the scale reading to 400° C.

(c) RECEIVERS.—The glass receivers may be of any convenient shape and size. One hundred cubic centimeter Erlenmeyer flasks are, however, recommended.

(d) SHIELD.—A shield 10 c.m. in diameter and 8 c.m. high, made of asbestos, must be provided.

(e) SUPPORT FOR FLASK.—The flask must rest on an asbestos board ½ c.m. in thickness by 15 c.m. in diameter, a hole 5 c.m. in diameter being cut in the center of the board. The board shall rest on a ring stand.

The apparatus must be assembled as shown in Fig. 2. The thermometer passes through a cork in the top of the flask, and is so placed that the top of the bulb of the thermometer is on a line with the bottom of the tubular outlet. The asbestos shield is placed around the bulb of the flask, and the flask mounted on the asbestos board supported on the ring stand, as shown in Fig. 2.

Two hundred grams of oil shall be used in the analysis, this amount being weighed on a balance sensitive to 1 m.g. in the following manner:

The flask is first placed on the pan of the balance and weighed and the weight recorded. Without removing the flask a 200-gram weight is placed on the opposite pan of the balance and a sufficient quantity of oil dropped into the glass through a long stem funnel to bring the pans into equilibrium. The flask is then removed from the balance and set up as shown in Fig. 2. Care must be taken that

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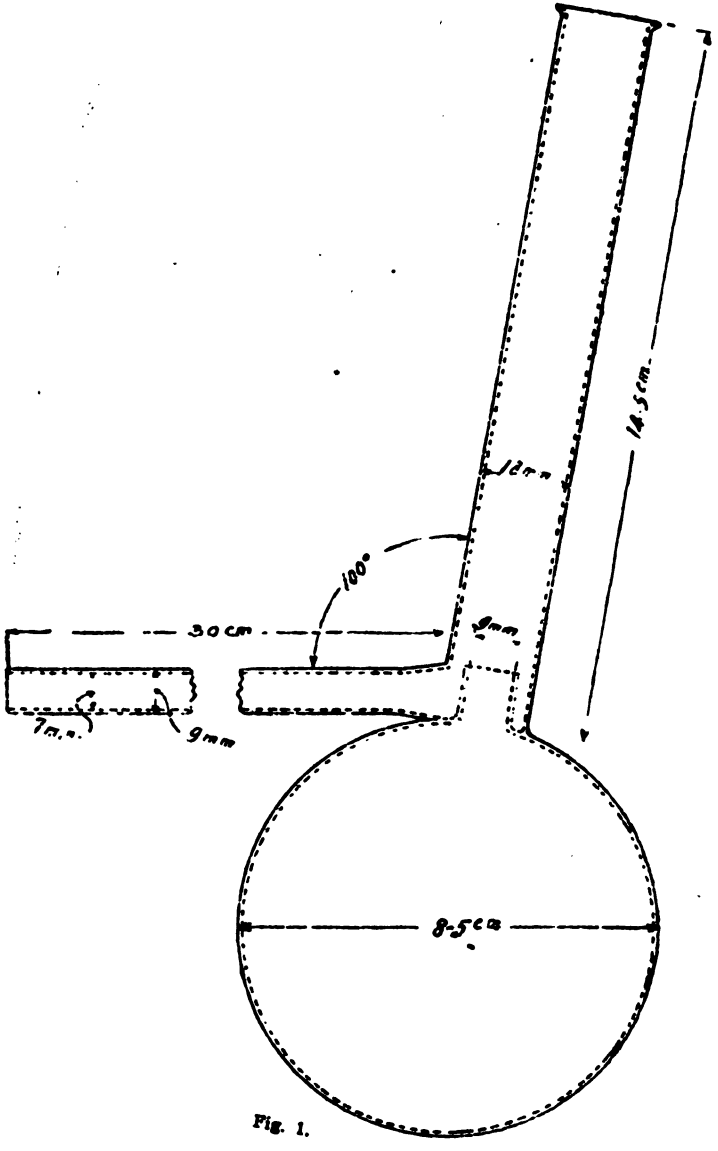

Fig. 1.

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the cork stopper carrying the thermometer fits tightly into place. The flask should be heated, preferably by a Bunsen

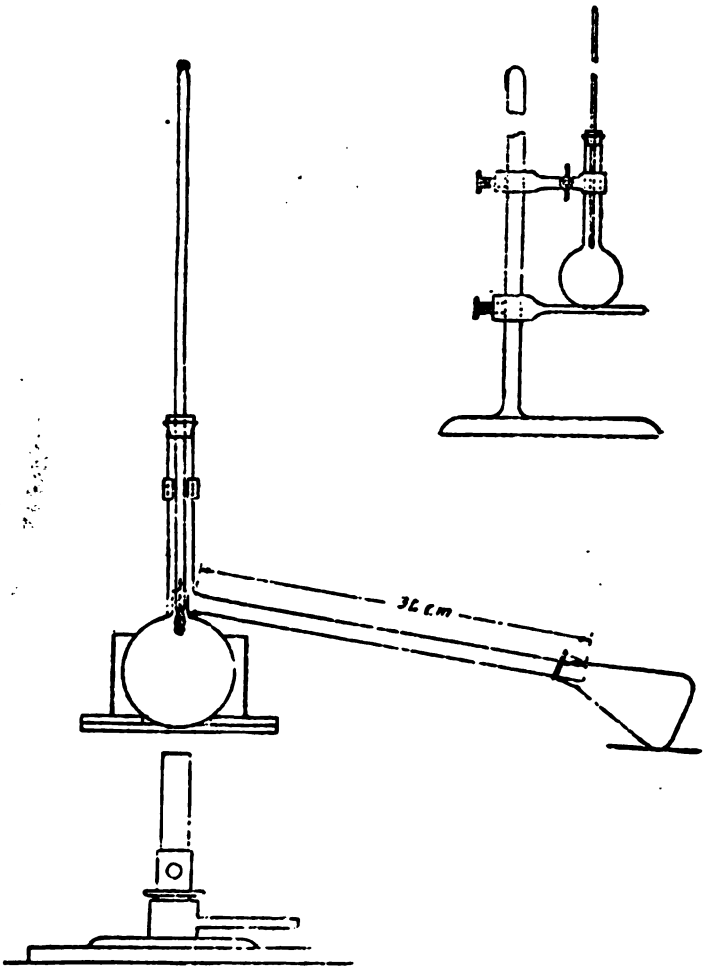

Fig. 2.

or other standard form of gas burner. The distillation shall be continuous and at such a rate that two drops of oil per second leaves the end of the tubular after the thermometer registers 205° C. or after all the water has been driven off.

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The percentage weights of the following fractions shall be recorded:

To 205° C.
To 235° C.
To 245° C.
To 270° C.
To 315° C.
To 360° C.

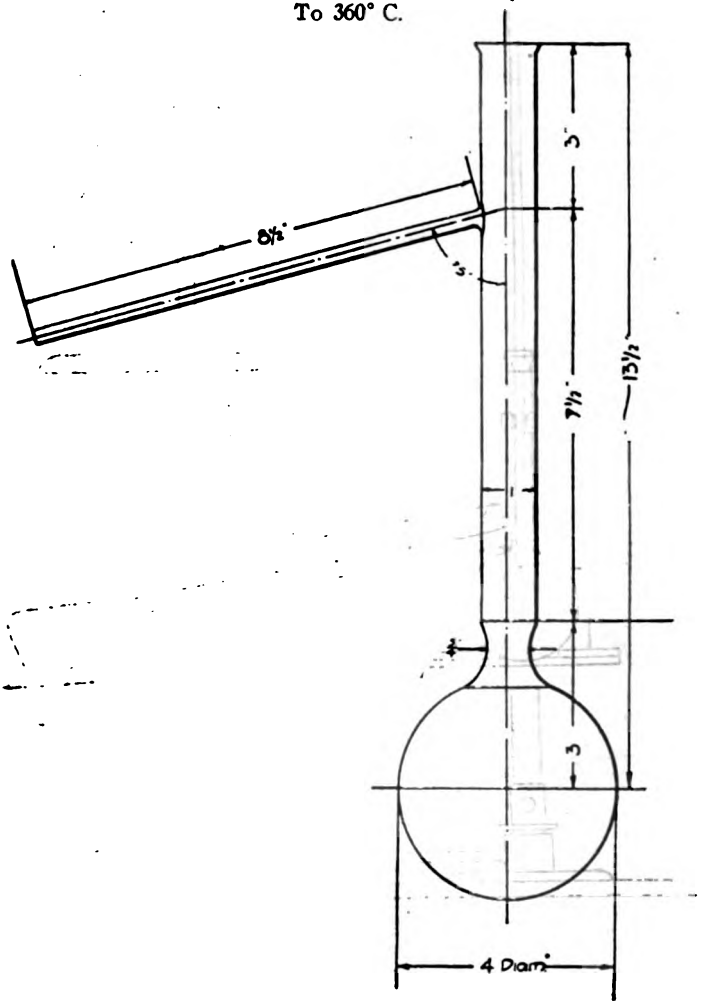

Fig. 3.

Hempel flask distillation, Forest Service method of testing:

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The flask used for this test is shown in Fig. 3. The specifications for the flask are as follows:

(1). The flask must be of Jena glass or its equivalent.

(2). The size of the flask must not vary more than 1/16 in. from the dimensions given in the figure, except the bulb which must contain approximately 500 c.c.

(3.) The complete apparatus should weigh approximately 175 grams.

In setting up the apparatus for distillation a loose plug of wire or other suitable arrangement for holding beads is dropped into the flask and lodged against the restriction at the neck of the flask. Approximately 200 large beads are placed above the plug of wire. The height of the bead column so formed must be exactly 5 ins. with a tolerance of ⅛ inch. The thermometer is placed in such manner that the top of the bulb (if the thermometer has a secondary bulb then this point must be taken in place of the top of the bulb) is just below the side outlet. A short air condenser is used.

The flask is placed on an asbestos board in which is cut a large hole slightly smaller than the greatest diameter of the flask. This hole is further enlarged by a number of triangular notches. The bulb of the flask is protected from drafts by a cylinder of asbestos paper 2 ins. high fitted with a cover, in the center of which a hole is provided for the Hempel column to protrude above the shield.

The distillation is run at the rate of between 60 and 120 drops per minute. Two hundred and fifty grams of oil is used for each distillation, and fractions are taken every 10°, beginning with 205° until 315° has been reached. Beyond that point the fractions are 330 and 360 degrees C., etc. This method is not intended for control work at the plant so much as a method to be used for purchase and sale of materials and for scientific investigation work.

Tar Acids.

Method of testing from A. R. E. A. Manual, 1915:

For the determination of low-boiling tar acid the fractions should be placed in the separating funnel, to which has been added 30 c.c. of 15% hot sodium hydroxide solution, vigorously shaken, and allowed to stand until the dissolved phenols separate and are drawn off; after which repeat with successive sodium hydroxide solutions, 20 c.c. each time, until no phenols are left (the sodium solution comes off clear). The phenols so obtained should be separated by the addition of 25% sulphuric acid slowly stirred in. When this reaction is complete the phenols so obtained should be decanted and weighed.

Method of testing from N. E. L. A. Proceedings, 1911:

One hundred cubic centimeters of the total distillate to 315° C., to which has been added 40 c.c. of a solution

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of sodium hydroxide having a specific gravity of 1.15, is warmed slightly and placed in a separatory funnel. The mixture is vigorously shaken, allowed to stand until the oil and soda solutions separate, and the soda solution containing most of the tar acids drawn off. A second and third extraction is then made in the same manner using 30 and 20 c.c. of the soda solution, respectively. The three alkaline extracts are united in a 200 c.c. graduated cylinder and acidified with dilute sulphuric acid. The mixture is then allowed to cool and the volume of tar acids noted. The results shown to be calculated to the original oil.

A revision of the test of the American Society for Treating Materials is being considered by that society.

Sulphonation Test.

Test according to the Forest Service method of testing:

Ten cubic centimeters of the fraction of creosote to be tested are measured into a Babcock milk bottle. To this is added 30 to 40 c.c. of 37 times normal sulphuric acid, 10 c.c. at a time. The bottle with its contents is shaken for two minutes after each addition of 10 c.c. of acid. After all the acid has been added to the bottle it is kept at a constant temperature of from 98° to 100° C. for one hour, during which time it is shaken vigorously every 10 minutes.

At the end of an hour the bottle is removed, cooled, and filled to the top of the graduation with ordinary sulphuric acid and then whirled for 5 minutes in a Babcock separator. The unsulphonated residue is then read off from the graduations. The reading of the major graduation multiplied by 2 gives the per cent. by volume directly.

Test taken from N. E. L. A. Proceedings, 1911:

Ten cubic centimeters of the total distillate to 315° C. are placed in a flask and warmed with four to five volumes of concentrated sulphuric acid to 60° C. and the whole transferred to a graduated separatory funnel (Fig. 4).

The flask is rinsed three times with small quantities of concentrated sulphuric acid and the rinsings added to the contents of the funnel, which is then stoppered and shaken cautiously at first, afterwards vigorously for at least 15 minutes and allowed to stand over night. The acid is then carefully drawn down into the graduated portion of the funnel to within 2 c.c. of where the unsulphonated residue shows. If no unsulphonated residue is visible the acid should be drawn down to 2 c.c.

In either case the test should be carried farther as follows:

Add 25 c.c. of water and allow to stand for one-half hour, then draw off the water as close as possible without drawing off any supernatent oil or emulsion. Add 10 c.c.

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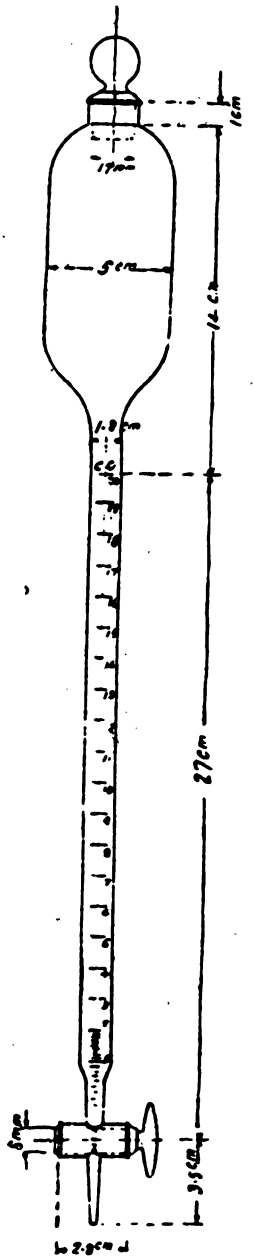

Fig. 4.

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of strong sulphuric acid and allow to stand for 15 or 20 minutes. Any unsulphonated residue will now separate out clear and give a distinct reading. If under 0.2 c.c. it should be drawn down into the narrow part of the funnel to just above the stop cock where it can be estimated to 0.01 c.c. The volume of residue thus obtained is calculated to the original oil.

Determination of Free Carbon or Insoluble Matter.

Test taken from the Proceedings of the N. E. L. A.:

The apparatus required is as follows:

Knorr condenser, Knorr flask, S. & S. No. 575 filter paper, 15 c.m. in diameter, wire for supporting filter paper.

Ten grams of the oil should be weighed in a small beaker and digested with c.p. toluol on the steam bath. A cylindrical filter cup is prepared by folding two of the papers around a rod 5/8 in. in diameter. The inner paper should be cut to 15 c.m. diameter. Prior to using the filter papers they should have been extracted with benzol to render them fat-free. The filter cup is dried at 100 c.c. and weighed in a weighing bottle.

The contents of the beaker are now decanted through the filter cup, and the beaker washed with hot toluol passing all washings through the cup. The filtrate should be passed through the filter a second time. The residue washed two or three times with hot c.p. benzol and transferred to the extraction apparatus in which c.p. benzol is used as a solvent which is vaporized by means of a steam or water bath. The extraction is continued until the filtrate is colorless. The filter cup is then removed, dried, and weighed in the weighing bottle. Chemically pure benzol followed by chloroform may be used instead of c.p. toluol followed by benzol.

Tentative method suggested by the A. S. T. M., 1916:

(a.) The extractor shall be of the form shown in Fig. 7, or any similar form in which the oil is subjected to direct washing by the boiling vapors of the solvent.

(b.) The filtering medium may be either two thicknesses of S. & S. No. 575 hardened filter paper, 15 c.m. in diameter, arranged in cup-shape by folding symetrically or alundum thimbles flat bottom 30 by 80 R. A. 98.

If filter papers are used, prior to using they should be soaked in benzol to remove any grease, dried in a steam oven and kept in a dessicator until ready to be used. The filter paper cup may be suspended in the extractor flask by a wire basket hung from two small hooks on the under surface of the metal cover of the flask. If the alundum thimble is used it may be supported by two perforations at the top of the thimble and suspended from the cover by German silver or platinum wires.

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Weigh 10 grams of dry oil into 100 c.c. beaker. Add 50 c.c. of pure benzol and transfer at once to the filter cup. The filter cup or thimble is previously weighed, and the paper cup should always be kept in a weighing bottle until ready for use. Wash out the beaker with benzol, passing all washings through the filter cup and place latter at once in the extraction apparatus. The extractor shall contain a suitable quantity of pure benzol. Sufficient heat to boil the solvent shall be provided by means of an electric heater or steam bath. Continue the extraction until the descending solvent is practically colorless and remove the filter cup and dry in steam oven until all solvent is driven off. Cool in desiccator and weigh. The balance for this purpose should be accurate to within .5 of a milogram.

Naphthalene Test.

Test taken from A. R. E. A. Manual, 1915:

The fractions remaining after extraction of phenols from the distillate should be placed in a conical vessel, such as a graduate and surrounded by freezing mixture of ice and salt, and allowed to remain until completely frozen. The naphthalene so frozen should be chopped up with a knife or mashed and placed into a small brass cylinder about 1½ ins. in diameter by 4 ins. long, open at both ends, but fitted with small brass plates or plugs.

Before putting the naphthalene, place several thicknesses of blotting paper, cut to fit the cylinder, on the bottom of the plate, and before putting in the top plate introduce similar blotting pads. Place several sheets of blotting on a plate of a copper press. put cylinder so charged in the press and apply pressure to the top plate or plug, leaving it for one hour. A clean plug of clean naphthalene is the result and may be taken out and weighed.

Coke Test.

Test taken from N. E. L. A. Proceedings, 1911:

In making the coke determination hard glass bulbs similar to the one shown in Fig. 15 are to be used.

The test is to be carried out as follows:
Warm the bulb slightly to drive off all moisture, cool in a dessicator, and weigh. Again heat the bulb by placing it momentarily in an open Bunsen flame, and allow the bulb to cool until sufficient oil is sucked in to fill the bulb about two-thirds full.

Any globules of oil sticking to the inside of the tubular should be drawn into the bulb by shaking or expelled by slightly heating it. The outer surface should be carefully wiped off, and the bulb reweighed. This procedure will give about 1 gram of oil.

Cut a strip of thin asbestos paper about ¼ in. wide and 1 in. long. Place it around the neck of the bulb and attach the two free ends close up to the neck with a pair of crucible tongs. The oil should then be distilled off as in

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making an ordinary oil distillation, starting with a very low flame and conducting the distillation as fast as can be maintained without spurting.

When oil ceases to come over the heat should be increased until the highest temperature of the Bunsen flame is obtained, the whole bulb being heated red hot until the evolution of gases cease and any carbon sticking to the outside of the tubular is completely burned off. The bulb should then be cooled in a dessicator and weighed and the percentage of coke residue calculated to water-free oil.

Index of Refraction Values of the Fractions.

Forest Service method of testing:

The instrument used for the determination of the index of refraction is known as the Abbey refractometer. Other refractometers are on the market, but this type of instrument is simplest and is more than sufficiently accurate for this purpose. It is so constructed that the prism of the instrument and, hence, the oil under examination can be kept at any desired temperature. For this work a temperature of 60° C. is used, because, at this temperature nearly all of the fractions are liquid. A higher temperature is not desirable because of the danger of injuring the instrument. The detail manipulation is omitted here, because it is believed it would only lead to confusion.

Specific Gravity of the Fractions.

A convenient method offered by the manufacturers of oil, also used by the Forest Service, is:

On account of the small size of the fraction, an ordinary specific gravity hydrometer cannot be used for this determination, the best instrument for this purpose being an ordinary Westphal balance with a plummet or bob of approximately 2 c.c. displacement. Instruments are made having this displacement which are accurate to one in the third decimal place, but they are somewhat more expensive than the ordinary Westphal balance. A smaller bob, can, however, be made with a little skill in glass blowing such as a chemist usually has, which will answer the purpose. Such a plummet will, of course, have a different displacement than the original one, and unless this is compensated for the readings will be of no value. The easiest way to compensate for this difference is by putting the instrument in balance when the plummet is immersed in water and the weights show a specific gravity of 1. This can be accomplished by the use of an additional weight at the end of the beam. Since no correction factors for transferring the specific gravity of the fractions from one temperature to another are available it is necessary that the gravity be taken at a standard temperature. This temperature is 60° C.

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REPORT OF SUB-COMMITTEE B.

Instructions to this Sub-Committee were as follows:

Present for adoption:

Specifications for creosote oil for ties and structural timber.

Specifications for coal-tar oil for paving blocks.

One standard method for making each test required in determining whether a material meets the requirements of a specification.

Specifications recommended for adoption must be supported by the data on which they are based.

Specifications recommended for adoption are as follows:

Creosote Oil for Ties and Structural Timber.

The oil shall be a distillate of coal-gas tar or coke-oven tar. It shall comply with the following requirements:

1. It shall not contain more than 3% of water.

2. It shall not contain more than 0.5% of matter insoluble in benzol.

3. The specific gravity of the oil at 38° compared with water at 15.5° C. shall be not less than 1.03.

4. The distillate, based on water-free oil, shall be within the following limits:

Up to 210° C. not more than 5%.
Up to 235° C. not more than 25%.

5. The specific gravity of the fraction between 235° C. and 315° C. shall be not less than 1.03 at 38° compared with water at 15.5° C.

The specific gravity of the fraction between 315° and 355° C. shall be not less than 1.10 at 38° compared with water at 15.5° C.

6. The residue above 355°, if it exceeds 5%, shall have a float-test of not more than 50 seconds at 70° C.

7. The oil shall yield not more than 2% coke residue.

8. The foregoing tests shall be made in accordance with the standard methods of the American Wood-Preservers' Association.

Creosote-Coal-Tar Solution for Ties and Structural Timber.

The oil shall be a coal-tar product, of which at least 80% shall be a distillate of coal-gas tar or coke-oven tar, and the remainder shall be refined or filtered coal-gas tar or coke-oven tar. It shall comply with the following requirements:

1. It shall not contain more than 3% of water.

2. It shall not contain more than 2% of matter insoluble in benzol.

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3. The specific gravity of the oil at 38° compared with water at 15.5° C. shall be not less than 1.05 or more than 1.10.

4. The distillate, based on water-free oil, shall be within the following limits:

Up to 210° C. not more than 5%.
Up to 235° C. not more than 25%.

5. The specific gravity of the fraction between 235° and 315° C. shall be not less than 1.03 at 38° compared with water at 15.5° C.

The specific gravity of the fraction between 315° C. and 355° C. shall be not less than 1.10 at 38° compared with water at 15.5° C.

6. The residue above 355° C., if it exceeds 26%, shall have a float-test of not more than 50 seconds at 70° C.

7. The oil shall yield not more than 6% coke residue.

8. The foregoing tests shall be made in accordance with the standard methods of the American Wood-Preservers' Association.

Coal-Tar Oil for Paving Blocks.

The oil shall be a coal-tar product, of which at least 65% shall be a distillate of coal-gas tar or coke-oven tar, and the remainder shall be refined or filtered coal-gas tar or coke-oven tar.

It shall comply with the following requirements:

1. It shall not contain more than 3% of water.

2. It shall not contain more than 3% of matter insoluble in benzol.

3. The specific gravity of the oil at 38° compared with water at 15.5 C. shall be not less than 1.07 or more than 1.12.

4. The distillate, based on water-free oil, shall be within the following limits:

Up to 210° C. not more than 5%.
Up to 235° C. not more than 25%.

5. The specific gravity of the fraction between 235° and 315° C. shall be not less than 1.03 at 38° compared with water at 15.5° C.

The specific gravity of the fraction between 315° and 355° C. shall be not less than 1.10 at 38° compared with water at 15.5° C.

6. The residue above 355° C. if it exceeds 35%, shall have a float-test of not more than 80 seconds at 70° C.

7. The oil shall yield not more than 10% coke residue.

8. The foregoing tests shall be made in accordance with the standard methods of the American Wood-Preservers' Association.

Distillate Oil for Paving Blocks.

The oil shall be a distillate of coal-gas tar or coke-oven tar. It shall comply with the following requirements:

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1. It shall not contain more than 3% of water.

2. It shall not contain more than 0.5% of matter insoluble in benzol.

3. The specific gravity of the oil at 38° compared with water at 15.5° C. shall be not less than 1.06.

4. The distillate, based on water-free oil, shall be within the following limits:

Up to 210° C. not more than 5%.
Up to 235° C. not more than 15%.

5. The specific gravity of the fraction between 235° and 315° C. shall be not less than 1.03 at 38° compared with water at 15.5° C.

The specific gravity of the fraction between 315° and 355° C. shall be not less than 1.10 at 38° compared with water at 15.5° C.

6. The residue above 355° C., if it exceeds 10%, shall have a float-test of not more than 50 seconds at 70° C.

7. The oil shall yield not more than 2% coke residue.

8. The foregoing tests shall be made in accordance with the standard methods of the American Wood-Preservers' Association.

The Committee recommends for adoption the following methods of testing:

1.—Water.

APPARATUS.—*Copper stills shown in Figs. 5 and 6—below:*

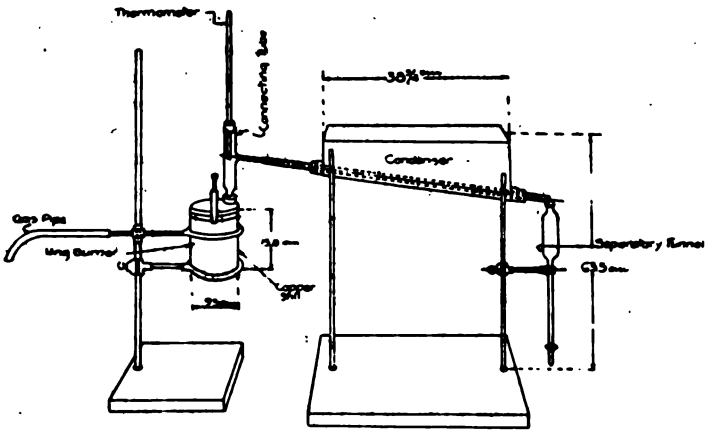

Fig. 5.

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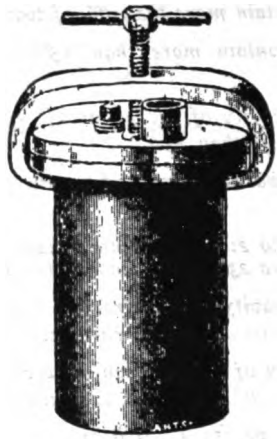

Fig. 6.

METHOD.—*When any measurable amount of water is present in the distillate below 210°, on testing in accordance with Section 4, Distillation, the oil and water in this fraction shall be separated, if possible, and measured separately. If more than 2% of water is present, or if the water is apparently present to an extent in excess of 2%, but an accurate separation is impossible, the percentage of water present shall be determined by the following method, and the water-free oil so obtained shall be used in distillation test, as described under Section 4.*

Measure 200 c.c. of oil in graduated cylinder, and pour into copper still, allowing the cylinder to drain into the still for several minutes. Attach lid and clamp, using a paper gasket slightly wet with oil around the flange of the still. Apply heat by means of the ring burner, which should be placed just above the level of the oil in the still at the beginning of the test, and gradually lowered when most of the water has distilled over. Continue the distillation until the vapor temperature indicated by the thermometer with the bulb opposite the offtake of the connecting tube, reaches 205° C. Collect distillate in separatory funnel.

When the distillation is completed, and a clear separation of water and oil in the funnel has taken place, the water is read by volume and drawn off, and whatever light oil has distilled over with the water is then returned to the oil in the still. The dehydrated oil from the still is then taken for distillation, described in Section 4, Distillation.

2. Insoluble in Benzol.

APPARATUS.—(A) *Extractor may be of the form shown in Fig. 7, or any similar form in which the oil is subjected to direct washing by the boiling vapors of the solvent.*

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(B) Filtering medium may be either two thicknesses of S. & S. No. 575 or Whatman No. 5 hardened filter paper, 15 c.m. in diameter

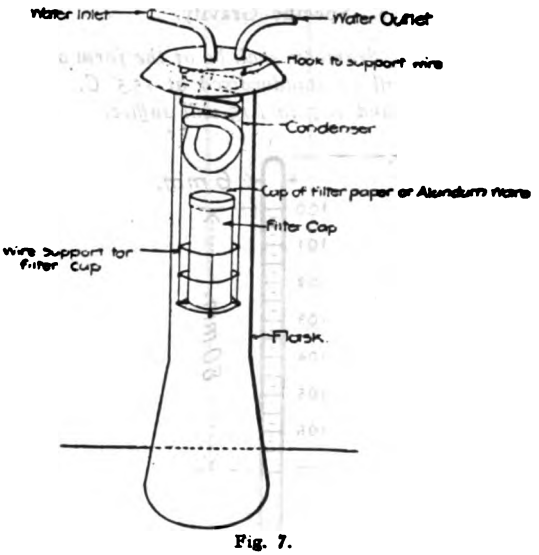

Fig. 7.

arranged in cup-shape by folding symmetrically; or alundum thimbles, flat bottom, 30x80 RA 98. If filter papers are used, prior to using they shall be soaked in benzol to remove grease, dried in a steam oven and kept in a desiccator until ready to be used. The filter-paper cup may be suspended in the extractor flask by a wire basket hung from two small hooks on the under surface of the metal cover of the flask.

If the alundum thimble is used, it may be supported by making two perforations in the top of the thimble, and suspending from the cover by German silver or platinum wires.

METHOD.—*Weigh 10 grams of dry oil in 100 c.c. beaker. Add about 50 c.c. of pure benzol, and transfer at once to the filter cup. The filter cup or thimble is previously weighed, and the paper cup shall always be kept in a weighing bottle until ready for use. Wash out the beaker with benzol, passing all washings through the filter cup, and place the latter at once in the extraction apparatus.*

Extractor shall contain a suitable quantity of pure benzol. Sufficient heat to boil the solvent shall be provided by means of an electric heater or a steam bath.

Continue the extraction until the descending solvent is practically colorless, and remove the filter cup and dry in steam oven until all

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solvent is driven off; cool in desiccator and weigh. The balance used for this purpose should be accurate to 0.5 m.g.

3. Specific Gravity.

APPARATUS.—(A) *Hydrometer shall be of the form and dimensions shown in Fig. 8. It shall be standardized at 15.5° C. A set of two with ranges 1.00 to 1.08 and 1.07 to 1.15 will suffice.*

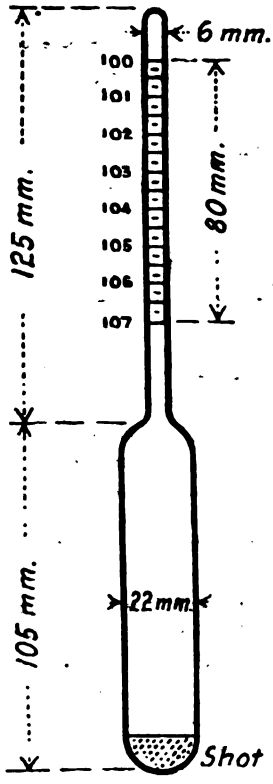

Fig. 8.

(B) *Cylinder shall be of the form and dimensions shown in Fig. 9.*

METHOD.—*The oil shall be brought to a temperature of 38° C. (100° F.), and the determination shall be made at that temperature unless the oil is not entirely liquid at 38° C. In case the oil requires to be brought to a higher temperature than 38° in order to render it completely fluid, it shall be tested at the lowest temperature at which it is*

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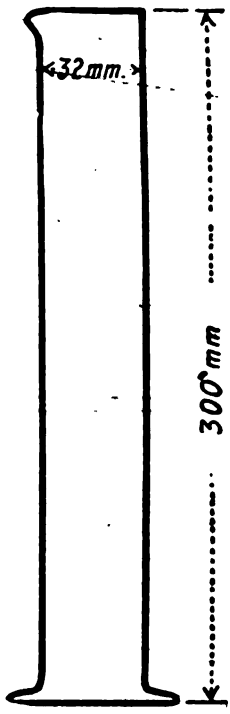

Fig. 9.

completely fluid, and a correction made by adding 0.0008 to the observed specific gravity for each degree Centigrade above 38° C. at which the test is made. This correction factor does not apply with equal accuracy to all oils, but serious error, due to its use will be avoided if the foregoing precaution is observed, with respect to avoiding unnecessarily high temperature.

4. Distillation.

APPARATUS.—(A) *Retort shall be a tubulated glass retort of the usual form with a capacity of 250 to 290 c.c. The capacity shall be measured by placing the retort with the bottom of the bulb and the end of the offtake in the same horizontal plane, and pouring water into the bulb through the tubulature until it overflows the offtake. The amount remaining in the bulb shall be considered its capacity (Fig. 10).*

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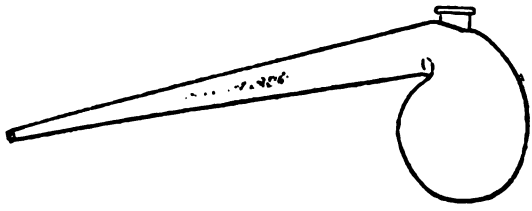

Fig. 10.

(B) *Condenser tube of any suitable form of glass tubing may be used; a convenient one is shown in Fig. 11.*

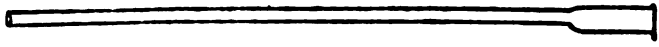

Fig. 11.

(C) *Shield of asbestos as shown in Fig. 12 shall be used to protect the retort from air currents, and to prevent radiation. This may*

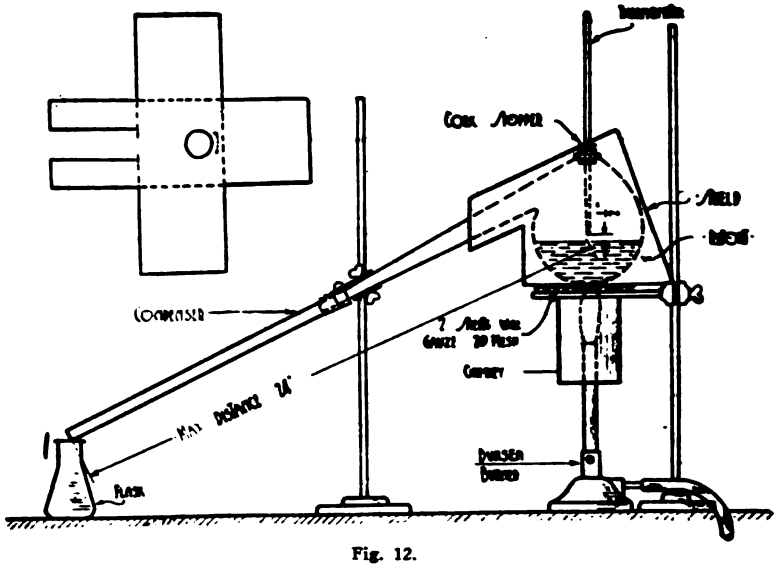

Fig. 12.

be covered with galvanised iron, as such an arrangement is more convenient and more permanent.

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(D) *Receivers (Erlenmeyer flask) of 50 to 100 c.c. capacity are most convenient form.*

(E) *Thermometer shall be made of resistance glass of a quality equivalent to suitable grades of Jena or Corning make. It shall be thoroughly annealed. It shall be filled above the mercury with inert gas which will not act chemically on or contaminate the mercury, The pressure of the gas shall be sufficient to prevent separation of the mercury column at all temperatures of the scale. There shall be a reservoir above the final graduation large enough so that the pressure will not become excessive at the highest temperature.*

The thermometer shall be finished at the top with a small glass ring or button suitable for attaching a tag. Each thermometer shall have for identification the maker's name, a serial number and the letters "A. S. T. M. Distillation."

The thermometer shall be graduated from 0 to 400° C. at intervals of 1° C. Every fifth graduation shall be longer than the intermediate ones, and every tenth graduation beginning at zero shall be numbered. The graduation marks and numbers shall be clear cut and distinct.

The thermometer shall conform to the following dimensions:

Total length, m.m., 385 maximum.

Diameter of stem, m.m., 7, tolerance 0.5.

Diameter of bulb, m.m., 5 minimum, and shall not exceed that of the stem.

Length of bulb, m.m., 12.5, tolerance 2.5.

Distance 0° to bottom of bulb, 30, tolerance 5.

Distance 0° to 400° C., 295, tolerance 10.

The accuracy of the thermometer when delivered to the purchaser shall be such that when tested at full immersion the maximum error from 0° to 200° C. shall not exceed 0.5°; 200° to 300° C. it shall not exceed 1° C.; 300° to 375° C., it shall not exceed 1.5° C.

The sensitiveness of the thermometer shall be such that when taken at a temperature of 26° C., and plunged into free flow of steam, the meniscus shall pass the 90° C. mark in not more than six seconds.

The retort shall be supported on a tripod or rings over two sheets of 20-mesh gauze, 6 ins. square. It shall be connected to the condenser tube by a tight cork joint. The thermometer shall be inserted through a cork in the tubulature with the bottom of the bulb ½ in. from the surface of the oil in the retort. The exact location of the thermometer bulb shall be determined by placing a vertical rule graduated in divisions not exceeding 1/16 in. back of the retort when the latter is in position for the test, and sighting the level of the liquid and the point

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for the bottom of the thermometer bulb. The distance from the bulb of the thermometer to the outlet end of the condenser tube shall be not more than 24 nor less than 20 ins. The burner shall be protected from draughts by a suitable shield or chimney (Fig. 12.)

METHOD.—*Exactly 100 grams of oil shall be weighed into the retorts, the apparatus assembled, and heat applied. The distillation shall be conducted at the rate of at least one drop and not more than two drops per second, and the distillate collected in weighed receivers. The condenser tube shall be warmed whenever necessary to prevent accumulation of solid distillates. Fractions shall be collected at the following points: 210°, 235°, 270°, 315°, and 355° C.*

The receivers shall be changed as the mercury passes the dividing temperature for each fraction. When the temperature reaches 355°, the flame shall be removed from the retort, and any oil which has condensed in the offtake shall be drained in the 355° fraction.

The residue shall remain in the retort with the cork and the thermometer in position until no vapors are visible; it shall then be weighed and carefully poured directly into the brass collar for float-test (see Section 6), or into a tin box and covered and allowed to cool to air temperature.

If the residue becomes so cool that it cannot be poured readily from the retort, it shall be re-heated by holding the bulb of the retort in hot water or steam, and not by the application of flame. The float-test shall be made on this residue as described (Section 6.)

For weighing the receivers and fractions, a balance accurate to at least 0.05 g. shall be used.

During the progress of the distillation the thermometer shall remain in its original position. No correction shall be made for the emergent stem of the thermometer.

When any measurable amount of water is present in the distillate, it shall be separated as nearly as possible and reported separately, all results being calculated on a basis of dry oil. When more than 2% of water is present, water-free oil shall be obtained by separately distilling a larger quantity of oil, returning to the oil any oil carried over with the water, and using dried oil for final distillation. (See Section 1, Water.)

5. Specific Gravity of Fractions.

As specific gravity is an absolute physical determination, any recognized method which can be applied to the quantity and quality of material at hand to be tested, must be considered satisfactory. The following methods are recommended by the Committee as convenient and accurate means for the relatively small amounts of oil available in determining gravity of fractions to be tested.

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Liquid Fractions.

APPARATUS.—*Westphal balance.*

METHOD.—*If the fraction to be tested is liquid at a temperature not exceeding 60° C., the Westphal balance can be used with convenience and rapidity. A special type of Westphal balance is obtainable, designed for testing very small quantities. However, the ordinary type Westphal balance can be adapted to testing small fractions by the use of a special plummet. This can readily be made in the laboratory from a piece of ordinary glass tubing 7 m.m. outside diameter, sealed at the end, and melting into the glass where sealed a short platinum wire.*

After cooling place 9 to 10 grams of mercury in the tube, making a column 35 to 40 m.m. high. Seal off the tube within 20 m.m. of the top of the mercury column with blowpipe flame. The plummet should have a length of about 55 to 60 m.m. over all, and should weigh between 10 and 12 grams.

Solid and Semi-Solid Fractions.

APPARATUS.—*Special platinum or nickel pan as shown in Figs. 13a and 13b.*

METHOD.—*For the determination of fractions that are solid or semi-solid and cannot readily be liquefied at a temperature not exceeding 60° C., a weighing pan constructed of platinum or nickel (Figs. 13a and 13b) may be used.*

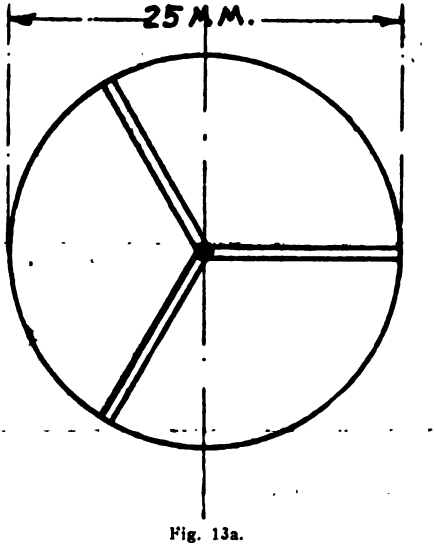

Fig. 13a.

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A pan of convenient dimensions is 20 m.m. diameter at the base and 25 m.m. diameter at the top, and about 12 m.m. deep. It is made

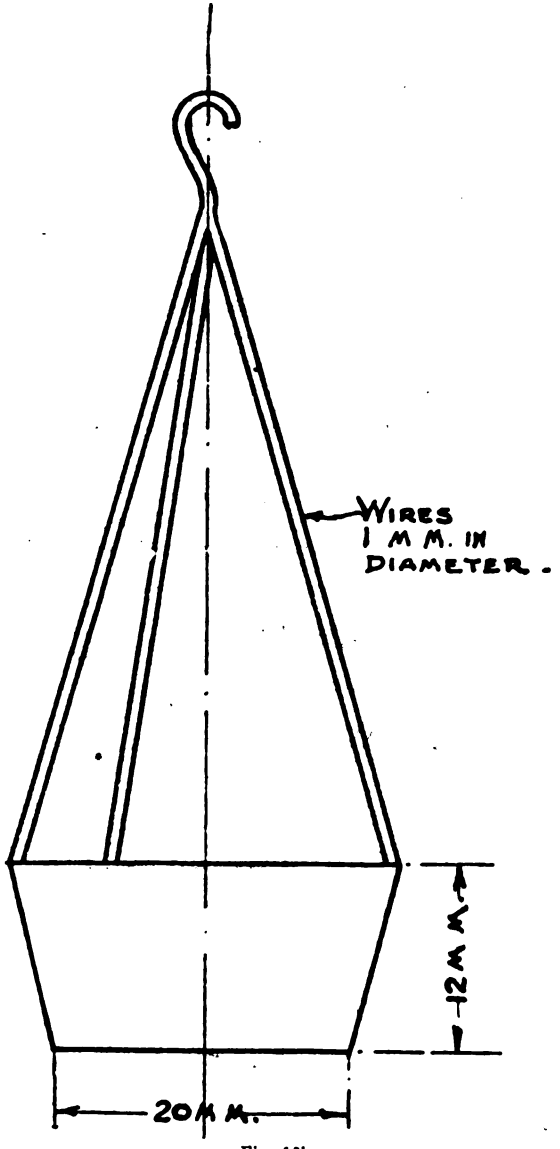

Fig. 13b.

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of platinum and supported by three platinum wires 1 m.m. in diameter, and has a total weight of about 7 grams.

Solid or semi-solid fractions of oil can be rapidly and accurately tested in this apparatus by the usual method of weighing in air and in water. The usual precaution, of igniting the pan before use, avoiding the enclosure of air or water in the sample, should be observed.

NOTE.—*The method for liquid fractions is usually applicable to the fractions 235 to 315° C. and the method for solid and semi-solid fractions to the fraction 315 to 355° C. In appendix are given examples of calculating the specific gravity of fractions at 38° C., compared with water at 15.5° C., by both of the foregoing methods.*

6. Float Test of Residue.

The residue taken as heretofore described (Section 4) shall be tested for consistency by the float-test.

APPARATUS.—*The float apparatus consists of two parts, an aluminum float or saucer and a conical brass collar (Fig. 14). The two parts are made separately, so that one float may be used with a number of brass collars.*

METHOD.—*In making the test, the brass collar is placed with the small end on the brass plate, which has been previously amalgamated with mercury by first rubbing it with a dilute solution of mercuric chloride or nitrate and then with mercury.*

The residue to be tested is either poured into the collar direct from the retort, as described in Section 4, or heated in a tin box on water or

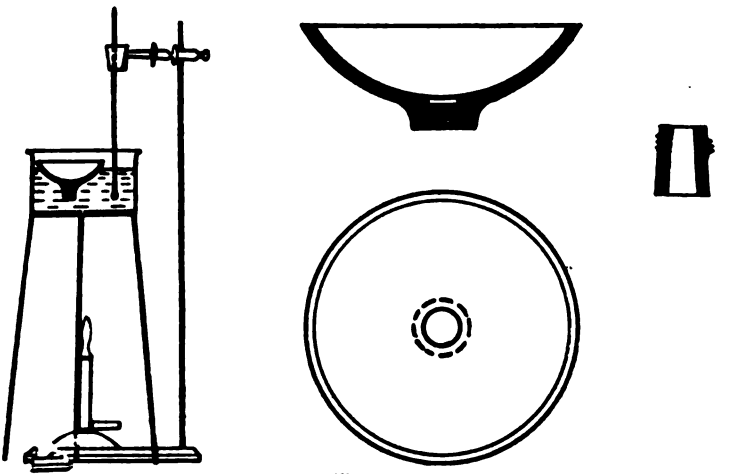

Fig. 14.

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steam bath, not by direct application of flame, and then poured into the collar in any convenient way, until slightly more than level with the top. The surplus may be removed after the material has cooled to room temperature, by means of spatula or steel knife which has been slightly heated. The collar and plate are then placed in one of the tin cups containing ice water maintained at 5° C., and left in this bath for at least 15 minutes.

Meanwhile the other cup is filled about three-fourths full of water and placed on the tripod, and the water is heated to any desired temperature at which the test is to be made. This temperature should be accurately maintained, and should at no time throughout the entire test be allowed to vary more than one-half a degree Centigrade from the temperature selected.

After the material to be tested has been kept in the ice water for at least 15 minutes and not more than 30 minutes, the collar with its contents is removed from the plate and screwed into the aluminum float, which is then immediately floated in the warmed bath. As the plug of bituminous material becomes warm and fluid, it is forced upward and out of the collar, until the water gains entrance to the saucer and causes it to sink.

The time in seconds between placing the apparatus on the water and when the water breaks through the bitumen is determined by means of a stop watch, and is taken as a measure of the consistency of the material under examination.

7. Coke Residue.

APPARATUS.—*Hard glass bulbs similar to the one shown in Fig, 15 are to be used.*

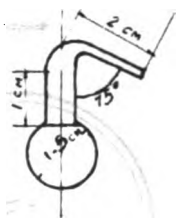

Fig. 15.

METHOD.—*Warm the bulb slighly to drive off all moisture, cool in a desiccator, and weigh. Again heat the bulb by placing it momentarily in an open Bunsen flame and place the tubular underneath the surface of the oil to be tested and allow the bulb to cool until sufficient oil is sucked in to fill the bulb about two-thirds full.*

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Any globules of oil sticking to the inside of the tubular should be drawn into the bulb by shaking or expelled by slightly heating it, and the outer surface should be carefully wiped off and the bulb re-weighed. This procedure will give about 1 gram of oil.

Cut a strip of thin asbestos paper about ¼ in. wide and about 1 in. long, place it around the neck of the bulb and catch the two free ends close up to the neck with a pair of crucible tongs. The oil should then be distilled off as in making ordinary oil distillation, starting with a very low flame and conducting the distillation as fast as can be maintained without spurting.

When oil ceases to come over, the heat should be increased until the highest temperature of the Bunsen flame is attained, the whole bulb being heated red hot until evolution of gas ceases, and any carbon sticking to the outside of the tubular is completely burned off. The bulb should then be cooled in a desiccator and weighed and the percentage of coke residue calculated to water-free oil.

The Committee desires to present in support of the specifications recommended, the following:

Creosote Oil for Ties and Structural Timber.

This specification is based on the standard specification for creosote oil of the American Railway Engineering Assoc. (Manual, 1915. page 541). The Committee offers the following with reference to each change made in the substance of the American Railway Engineering Association's specification:

The definition of the oil has been changed from

> The oil shall be the best obtainable grade of coal-tar creosote, that is, it shall be a pure product obtained from coal tar, gas tar, or coke-oven tar.

to read:

> The oil shall be a distillate of coal-gas tar or coke-oven tar.

The Committee believes that the latter definition is more clear, and therefore, less liable to misinterpretation. The clause "shall be free from suspended matter" has been omitted, and a requirement limiting insoluble matter to 0.5% is substituted therefor. The term "free from suspended matter," if interpreted rigidly, would bar out practically any commercial oil, which always contains traces of suspended matter, and if not so intrepreted, it is meaningless. The proposed requirement is a definite one, which prevents any unreasonable amount of adventitious material.

The requirement that the oil shall be completely liquid at 38° C. has been omitted. In the Committee's opinion, any oil complying with these specifications is sufficiently liquid at high temperatures to insure ease of handling, and it is a matter of no importance whether it is entirely liquid at 38° C. or not.

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The requirement that the "residue above 355° C., if it exceeds 5%, shall be soft," has been changed to a definite requirement. In other words, we have provided a means of determining whether the residue is soft or not, a point which heretofore has always been left to individual judgment. This test is of more significance in connection with the specifications for creosote-coal tar solution and coal-tar paving oil, and will be discussed more fully under those specifications.

Additional requirements, not included in the American Railway Engineering Association specifications, are specific gravity of fractions and the coke residue test. The requirements on specific gravity of fractions have been included in various specifications for creosote oil during the past four or five years. They are included in this and in other specifications here presented, because the Committee finds that these tests, more than any others that have been proposed or made known to its members, tend to exclude the admixture of products from water-gas tar or other products of petroleum origin that might be added to the oil for the purpose of cheapening it. The Committee submits an appendix to this report, giving results of tests indicating the value of this requirement.

The coke residue test is added to this and to other specifications, because the Committee finds that this test, in connection with the other requirements, does effectively bar out or control the addition of refined or filtered tars, or pitches. In the appendix are given data showing the value of this test on distillate oils as well as on creosote-coal tar solution and paving oils. The test was first proposed and adopted by the National Electric Light Association in 1911, and at that time had the approval of a committee containing a number of the leading authorities on creosote specifications. Your Committee now approves it as a practical, and at the same time, reasonably effective test for the purpose indicated.

The standard specification of the American Railway Engineering Association for creosote oil has been so widely recognized that the Committee feels no explanation is necessary in retaining the main requirements of that specification, and all the modifications hitherto recited are merely for the purpose of strengthening and modernizing said specification.

Difficulty in obtaining this oil in sufficient quantity to meet the requirements of the railroads and other consumers, led to consideration and the recommendation by the American Railway Engineering Association in 1912 of specifications for No. 2 and No. 3 grade of creosote oil. These specifications provided for oils of lower distilling range

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than the standard.* However, the present tendency is not in favor of the use of lower boiling oils, and the widely used mixture of distillate oils and refined or filtered tar has more recently been recognized by the American Railway Engineering Association under the term "creosote-coal tar solution." The latter is now used not only by reason of expediency or economy, but by many who believe a moderate tar addition of advantage.

Creosote-Coal Tar Solution for Ties.

This specification is based on the specifications for creosote-coal tar solution appearing in the American Railway Engineering Association Manual, 1915, page 546. The following changes have been made:

In the definition, a specific limit has been placed on the permissible percentage of refined or filtered tar that the oil may contain. The minimum specific gravity of the oil has been raised from 1.03 to 1.05, as no oils meeting the other tests would be likely to fall under 1.05.

The specific viscosity test in the old specification has been omitted. The data in the Committee's hands show variations in this test that are difficult to explain, and indicate that many oils that are entirely satisfactory might be barred out. Hence, the test is omitted as one tending to complicate the specification, without adding anything of proven value.

The maximum distillate permitted up to 235° C. has been lowered from 30 to 25%, in order reasonably to restrict the specification against the use of low-boiling oils.

The additional requirements of this specification not appearing in the American Railway Engineering Association specification, are the same as the additional requirements heretofore described under the specification for creosote oil.

Supplementing the explanations heretofore presented, the Committee calls attention to the function of the consistency test on residue above 355° C., and the coke test, in relation to controlling the permissible addition of refined or filtered tars. The percentage of tar can be pretty definitely limited by requiring that the residue above 355° C. shall not exceed a specific amount, as was done in the old specification. This, however, as shown by example given in appendix, will bar even

*The specifications recommended by the Committee are for types of oil, and the limits specified for the various requirements are fixed in accordance with the best information obtainable and the Committee's judgment. However, it is obvious that any of these specifications can be slightly modified if desired, without departing from the general type of oil specified, or from the general lines laid down in the specification. For example, if an oil similar to the American Railway Engineering Association No. 2 is desired instead of No. 1 or standard oil, the maximum distillates permitted at 210° and 235° C. could be altered as desired and no other alteration in the specification for creosote oil for ties would be necessary.

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the permissible addition contemplated by the specification in the case of higher boiling creosote, thus working to the disadvantage of the consumer as well as the producer. On the other hand, by requiring that the residue, if it exceeds a specific limit, shall have a definite softness, the integrity of the specification as to tar addition is maintained without prejudice to the use of high-boiling oils.

Reference to the appendix shows the value of the coke test as an additional check on the tar content of the oil. The analyses from which the maximum limit for the coke test in this and the other specifications was determined, were made in the laboratories of individual members of the Committee. In view of the comparatively recent origin of this test, additional data from members outside the Committee is desired, so that the limits can, at some later time, perhaps be made more restrictive. Meanwhile, the Committee feels safe in presenting the figures selected.

Coal Tar Oil for Paving Blocks.

This is substantially in accordance with a recommendation made to this Association a year ago by the special committee appointed for that purpose. This Committee finds, however, that the specification heretofore presented failed to meet with universal approval, for the reason that an attempt was made to permit within one specification a creosote-coal tar solution or a distillate creosote. This made necessary wider limits for specific gravity, distillation, etc., than seemed consistent to some. Other objections offered to the specification were that its requirements did not prevent adulteration with water-gas-tar products, and that the coal tar addition was not definitely controlled.

In the specification here presented, these objections are met by providing a separate specification for a distillate oil for paving blocks. The coal tar oil for paving blocks specification, like that for the creosote-coal tar solution for ties, defines specifically the permissible percentage of refined or filtered tars. In all the requirements of the specification it parallels closely the preceding specification, so that a detailed discussion of each separate requirement seems unnecessary. Reference to the appendix gives specific illustrations showing the applicability of the consistency test of the resdiue above 355° C., the specific gravity of fractions, and the coke residue, to this specification.

The specification for coal tar oil for paving blocks and the specification for distillate oil for paving blocks as then developed by this Committee, were submitted in September, 1916, at a joint conference meeting of the committees representing this Association, the American Society for Testing Materials, the American Society of Municipal Improvements, the American Society of Civil Engineers and the Southern

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Pine Association, and unanimously accepted by that meeting. In October, these specifications were adopted as standard by the American Society of Municipal Improvements at its annual meeting in Newark. Since then, the Committee has found that the specifications are strengthened by requiring higher specific gravities for certain fractions of the oil. Consequently, in the specifications now proposed, the specific gravity of the fraction 235 to 315° C. must be 1.03 and of the fraction 315 to 355° C., 1.10, instead of 1.02 and 1.09, respectively, as in the specifications adopted by the American Society of Municipal Improvements.

The Committee desires to state frankly that the tests provided by these specifications do not absolutely prevent addition of water-gas-tar products, provided the definition is disregarded by the manufacturers of the oil; but the proportion of such products that could be added without detection is so limited that it is not likely to be attempted. Your Committee is of the opinion that creosote oil, considering its low price in the commodity scale, is subjected by the tests required in these specifications to a greater rigidity of examination than the majority of higher-priced products.

The Committee wishes to state its belief that if an oil containing any considerable amount of water-gas-tar products be subjected to the test under these specifications, there will be sufficient indications to arouse the suspicions of an experienced inspector. The oils can then be subjected to a more rigid chemical examination, using tests which it is not practical to embody in a general specification.

Distillate Oil for Paving Blocks.

This specification follows exactly the same lines as the specification for creosote oil for ties and timbers, hence a discussion of each separate requirement is unnecessary. The specification, on the face of it, provides for high-boiling creosote oil, and is equally restricted as the preceding specifications against adulteration or tar addition. Your Committee believes that authorities are almost in accord in the belief that low-boiling oils are not well adapted to paving block requirements. The present specification provides an oil which can be commercially obtained without difficulty, and will meet the demands of those who do not approve of the use of the coal tar paving oil.

In presenting these four specifications, the Committee desires to be clearly understood as to the objects and purpose of its work. It has sought to clarify, improve and safeguard existing standards, rather than to develop new ones. It holds no brief for or against any type or grade of oil. The Committee's purpose has been accomplished, if, by reason of the adoption of these specifications, it becomes easier for the engineer to select that type of oil he desires, for the distiller to produce it, and for the inspector or analyst to determine that the specifications have been fulfilled.

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REPORT OF SUB-COMMITTEE C.

Instructions to this Sub-Committee were as follows:

Present for adoption:

Specifications for zinc chloride for general use:
Methods for sampling and testing.

Recommended for adoption by the Association.

Specification for Zinc Chloride.

The zinc chloride shall be free from acid and shall not contain more than 0.5% iron. It shall be furnished in solid (fused) state or in concentrated solution (usually 50%). The zinc chloride shall be furnished on the basis of the percentage of pure (100%) zinc chloride present.

The percentage iron content allowable in the specification was given thoughtful consideration by the Committee. They corresponded with several large zinc manufacturers regarding this subject. The conclusion arrived at by the Committee was that 0.5% of iron was a fair figure. If the percentage of iron allowable is made smaller than this, it tends to increase the cost of the zinc without commensurate advantage; if the percentage allowable is placed much higher than this figure, it permits of the manufacture of zinc chloride from low-grade raw materials.

Method of Analysis for Zinc Chloride.

The Association adopted a method for the analysis of zinc chloride in January, 1912. This was printed in the 1912 PROCEEDINGS, page 230 and reprinted in the 1915 PROCEEDINGS, page 131. As this method has proved satisfactory, the Committee decided it was not necessary at this time to suggest any revision.

Sampling Solid Zinc Chloride.

The question of sampling of solid zinc chloride for test purposes was considered by the Sub-Committee, but as no satisfactory method could be arrived at it was decided to recommend that this problem be included in the work outlined for next year's Committee on Preservatives.

REPORT OF SUB-COMMITTEE D.

The instructions to your Sub-Committee were as follows:

To present all the information available concerning the use of water-gas tar and oil for treating paving blocks, and, if in the judgment of the Committee it is warranted, a tentative specification for such oil.

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In accordance with these instructions, your Sub-Committee begs to report as follows:

It was found upon investigation that there are in existence many thousands of square yards of wood-paving that, judging from the chemical analysis of the original oil now in the blocks, had been originally treated either wholly, or in greater part with water-gas tar. In view, however, of the specifications and other conditions connected with the treatment and laying of many of these blocks, it did not seem advisable to include them in this report.

We have, however, submitted for your consideration the location, yardage, character of treatment, oil used, present condition, traffic conditions, and in some cases a photograph of a considerable number of streets that are paved with wood blocks that were treated with refined water-gas tar.

With the exception of two cases which are noted, your Sub-Committee by its personal knowledge is assured that the oil used was refined water-gas tar of the grade represented by the analysis and that the quantity injected per cubic foot was found from the block manufacturers' records to agree with the specifications. (Exhibit "A" to "L.")

The streets and locations listed in Tables I to V were inspected by your Sub-Committee during the spring and summer of 1916. These streets were found to be in the condition as noted in the tabulation. Where the condition of the pavement is not noted, it is because your Sub-Committee was unable to make a personal inspection of the paving, but they in all such cases made inquiries by letter and otherwise, and have been assured that the present condition of these uninspected streets is entirely satisfactory.

In passing judgment on the serviceability of a material for use in treating paving blocks, your Sub-Committee feels that there are four features to be considered:

(1). Water-proofing value of the material.
(2). Its preservative value as against decay.
(3). Permanency of the oil in the blocks.
(4). Ease and completeness of penetration.
(5). Its freedom from bleeding.

The water-proofing value of water-gas tar has been quite generally recognized, and a number of references in the literature and in the PROCEEDINGS of this Association are to be found bearing on this point. In addition, your Sub-Committee submits the results of the laboratory tests to determine this property that were made at the treating plant of blocks laid on the streets inspected. These are given in Table VI. It will be noted that these results indicate a uniformly high water-proofing value.

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As regards the preservative value of the material against decay, your Sub-Committee would report that it was unable to find any instance of decay in any of the blocks inspected by it, nor was any such decay reported from any of the uninspected work. Since a number of these streets have been in service for over eight years, your Sub-Committee feels justified in assuming that this feature of the requirements of a proper preservative has been amply fulfilled.

As regards the permanency of the oil in the blocks, your Sub-Committee submits in Tables VII and VIII, the analyses of the oil extracted from blocks from two streets that had been in service for eight years. An examination of the distillation of the recovered oil as compared with the original oil indicates that no material change has taken place after eight years' exposure.

The members of the Committee who were present at the inspection of the Sixth Avenue Bridge, at Pittsburgh, will recall the completeness with which the blocks were impregnated. This has been found to be characteristic of blocks that were inspected over a large number of locations, and is excellent evidence of the ease and thoroughness with which the preservative prepared from water-gas tar permeates the wood.

With regard to bleeding, your Sub-Committee would call particular attention to the fact that, from its inspections, and from the inquiries it made of those having the pavements in charge, there was an entire absence of any complaint from bleeding, not only as to the older pavements, but also on those of very recent construction.

Your Sub-Committee is convinced, therefore, that as a result of the fulfillment of the foregoing requirements, and in view of the uniformly successful results that were obtained, as evidenced by the examples cited in this report, the refined water-gas tar has demonstrated its value and usefulness as a preservative for wood-paving block.

It, therefore, recommends to the Committee that refined water-gas tar be recognized as a suitable and satisfactory wood-block preservative, and that the following specifications be submitted to the Association for adoption, as a standard specification for this class of material:

REFINED WATER-GAS TAR FOR PAVING BLOCKS.

The preservative shall be a refined water-gas tar. It shall comply with the following requirements:

1. *It shall contain not more than 3% of water.*
2. *It shall contain not more than 2% of matter insoluble in benzol and chloroform.*
3. *The specific gravity of the preservative at 38° compared with water at 15.5° C. shall not be less than 1.110, nor more than 1.140.*

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TABLE I.—LOCATION OF EXAMPLES OF WOOD-BLOCK PAVING.—BLOCKS TREATED WITH WATER-GAS TAR.

Year and City in Which Blocks were Laid.	Location of Blocks.	Square Yards (Approximate.)	Absorption per Cubic Foot of Lumber.	Analysis.	Photograph.	Traffic.	Condition.	Specification.
1908.				(A)*				
Boston, Mass.	Washington St. from 78' South of Court Ave. to Cornhill and State Sts. N. & S. of Old State House.	1300	20 lbs.		1	Heavy Heavy Heavy	Good Fair Fair	I I I
Pittsburgh, Pa.	6th St. Bridge Between Pittsburgh and Allegheny.	3228	20 lbs.		2	Heavy	Good	E
Havana, Cuba.	Shop Flooring.	4800	20 lbs.					E
New York, N. Y.	Rogers Place from Dongan to 165th St.	2975	20 lbs.			Light	Good	H
New York, N. Y.	Minford St., Boston Road to Jennings.	4541	20 lbs.			Light	Good	H
New York, N. Y.	Charlotte St., Boston Road to Jennings.	3644	20 lbs.		3	Light	Good	H
New York, N. Y.	Liberty Street Terminal.	1260	20 lbs.			Heavy	Good	E
Waterbury, Conn.	Intersection of West Main and Willow St.		20 lbs.			Heavy	Good	E
1909.				(B)				
Boston, Mass.	Bowdin St.	1583	20 lbs.			Light	Good	I
Boston, Mass.	Falmouth St.	1435	20 lbs.			Light	Good	I
Holyoke, Mass.	.....	1868	20 lbs.			Light	Good	E
Oakmont, Pa.	Bridge Floor	3915	16 lbs.		4	Light	Good	E

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TABLE II.—LOCATION OF EXAMPLES OF WOOD-BLOCK PAVING.—BLOCKS TREATED WITH WATER-GAS TAR.

Year and City in Which Blocks were Laid.	Location of Blocks.	Square Yards (Approximate.)	Absorption per Cubic Foot of Lumber.	Analysis.	Photograph.	Traffic.	Condition.	Specification.
1910.				(C)				
Asbury Park, N. J.	Flooring for Bridge at Deal Lake.	2038	16 lbs.			Heavy	Good	B
South Boston, Mass.	Milk St., Pearl to Oliver St.	2353	20 lbs.			Heavy	Good	I
	Pearl St., Milk St. to 148' North.					Heavy	Good	I
	Oliver St., Milk St. to 200' Southeast.					Heavy	Good	I
Philadelphia, Pa.	Flooring Pier 34 South Wharves.	4860	16 lbs.			Heavy	Fair	B
Eddystone, Pa.	Baldwin Locomotive Works Machine Shop Flooring.	7137	16 lbs.					B
1911.				(D & E)				
Newark, N. J.	Plank Road Bridge over Passaic River.	2562	20 lbs.			Heavy	Good	E
Bridgeport, Conn.	State St., Broad St. to Fairfield Ave.	24433	16 lbs.			Heavy	Good	L
Boston, Mass.	Milk St., Oliver to Broad St.	1096	20 lbs.			Heavy	Good	I
Boston, Mass.	Washington St., Williams to Dudley St.	4300	20 lbs.		5	Heavy	Good	I

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TABLE III.—LOCATION OF EXAMPLES OF WOOD-BLOCK PAVING.—BLOCKS TREATED WITH WATER-GAS TAR.

Year and City in Which Blocks were Laid.	Location of Blocks.	Square Yards (Approximate.)	Absorption per Cubic Foot of Lumber.	Analysis.	Photograph.	Traffic.	Condition.	Specification.
1911.				(D & E)				
Boston, Mass.	Ferdinand St., Fayette St. to B. & A. R. R.					Medium	Good	I
	Fayette St., Ferdinand to Pleasant St., Melrose St., Ferdinand to Pleasant St., Church St., Melrose to Fayette St.	5230	20 lbs.			Light	Good	I
1912.				(F & G)				
Cambridge, Mass.	Mass. St., Brattle Sq. to Bigelow.	27514	20 lbs.			Heavy	Good	C
	Harvard Sq., Brattle Sq. to Subway Entrance Including Mount Auburn St.					Heavy	Good	C
	Brattle Sq., Lafayette to Mass.					Heavy	Good	C
Philadelphia, Pa.	33 St., Race to Powelton Ave.	2928	18 lbs.			Light	Good	F
	48 St., Woodland Ave. to Gray's Ferry Road.					Moderate	Good	F
	Woodland Ave., 48 St. to P. & W. C. R. R.					Light	Good	F
Philadelphia, Pa.	Wallace St., 18th to 19th Sts.	3683	18 lbs.			Light	Good	F
	Hamilton St., 18th to 19th Sts.					Moderate	Good	F
	Hamilton St., 20th to 21st Sts.					Moderate	Good	F

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TABLE IV.—LOCATION OF EXAMPLES OF WOOD-BLOCK PAVING.—BLOCKS TREATED WITH WATER-GAS TAR.

Year and City in Which Blocks were Laid.	Location of Blocks.	Square Yards (Approximate.)	Absorption per Cubic Foot of Lumber.	Analysis.	Photo-graph.	Traffic.	Condi-tion.	Speci-fica-tion.
1912.				(F & G)				
East Cambridge, Mass.	Harvard Bridge	9509	20 lbs.		6	Heavy	Fair	I
New York City	2nd Ave., 18th to 19th Sts.		16 lbs.			Heavy	Good	M
	2nd Ave., 14th to 15th Sts. North from 14th St. E. Side.		20 lbs.			Heavy	Good	M
	2nd Ave., South of 7th St.		20 lbs.			Heavy	Good	M
Philadelphia, Pa.	Arch St., Front to 21st St.	40000	18 lbs.			Heavy	Good	F
1913.				(H)				
Waterbury, Conn.	Bank St.	2030	20 lbs.			Heavy	Good	I
Dorchester, Mass.	Washington St., Blue Hill Ave. to Talbet Ave.	10130	20 lbs.			Moderate	Good	I
New Britain, Conn.	West Main St.	7300	20 lbs.			Moderate	Good	E
Pittsfield, Mass.	Columbus Ave.	4000	20 lbs.			Moderate	Good	D
1914.				(I)				
Fitchburg, Mass.	Main St., Pritchard to Railstone St.	4000	20 lbs.					K
	Pritchard St., Main to Pleasant St.							K
	Railstone St., Main to Bridge St.							K
	Water St., 4th to 7th St.							K

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TABLE V.—LOCATION OF EXAMPLES OF WOOD-BLOCK PAVING.—BLOCKS TREATED WITH WATER-GAS TAR.

Year and City in Which Blocks were Laid.	Location of Blocks.	Square Yards (Approximate.)	Absorption per Cubic Foot of Lumber.	Analysis.	Photograph.	Traffic.	Condition.	Specification.
1914. Ansonia, Conn.	Main St., Bridge St. to Brass Factory.	.9627	20 lbs.	(1)		Heavy	Good	J
Meriden, Conn.	No. Colony St., Steam R. R. to 20 North of Wilcox Ave.	3000	18 lbs.					J
Jersey City, N. J.	Washington St., Montgomery to Grand St.	1190	20 lbs.					G
Philadelphia, Pa.	Locust St., Broad to 13th St.	1550	18 lbs.			Moderate	Good	A
Philadelphia, Pa.	Fifth St., Girard Ave. to 433' Southward.	1695	18 lbs.			Moderate	Good	A
Philadelphia, Pa.	11th St., Market to Chestnut St.	1410	18 lbs.			Heavy	Good	A
Philadelphia, Pa.	10th St., Market to Chestnut St.	1407	18 lbs.			Heavy	Good	A
Philadelphia, Pa.	9th St., Market to Chestnut St.	1363	18 lbs.			Heavy	Good	A
Jersey City, N. J.	York St., Van Verst to 255' East on Washington St.	4620	20 lbs.					G

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TABLE VI.—WATER ABSORPTION TESTS ON WOOD-PAVING BLOCKS TREATED WITH WATER-GAS TAR.

Year	City	Absorption.—Per Cent. No. of Samples.	Average.	Mean.	High.	Low.
1908	Pittsburgh, Pa.	9	2.38	2.68	3.57	1.78
1909	Oakmont, Pa.	5	4.00	4.50	6.40	2.60
1911	Bridgeport, Conn.	147	3.12	3.42	5.74	1.09
1911	Boston, Mass.	72	2.85	3.16	5.06	1.26
1911	Boston, Mass.	15	3.73	4.04	5.45	2.64
1911	Plank Road Bridge	2	0.44	0.44	0.43	0.45
1912	Cambridge, Mass.	96	2.18	2.54	4.08	1.01
1912	Philadelphia, Pa.	42	2.17	2.64	4.21	1.07
1912	Harvard Bridge	62	3.11	3.70	6.40	1.00
1913	Waterbury, Conn.	40	2.85	3.85	6.46	1.24
1913	Dorchester, Mass.	30	2.85	3.28	4.98	1.58
1913	New Britain, Conn.	40	2.67	3.19	5.25	1.13
1913	Pittsfield, Mass.	20	2.45	2.42	3.02	1.83

Absorption test, 24 hours at 100° F., 24 hours in water at room temperature.

TABLE VII.—PRESERVATIVE EXTRACTED FROM WOOD BLOCKS TAKEN FROM SIXTH STREET BRIDGE BETWEEN PITTSBURGH, PA., AND ALLEGHENY, PA.

SPECIFICATION SCHEDULE "E."

			Stock in 1908	Specification Schedule "E."
Specific Gravity at 38° C.	1.103			1.10-1.14
Distillation, Bulletin No. 65 Method.				
Up to 170° C.	Trace			Up to 150° C.
170-225° C.	9.6			0.5%
225-255° C.	3.8			
255-270° C.	2.7			
270-315° C.	13.4	29.5	32.3%	20-40%
315-360° C.	23.0	70.5	67.7%	
Above 360° C.	47.5			
Water				3%
Insoluble in Benzol and Chloroform				3.5%

TABLE VIII.—PRESERVATIVE EXTRACTED FROM WOOD BLOCKS TAKEN FROM INTERSECTION OF STATE ST.,—BROAD ST. TO FAIRFIELD AVE., BRIDGEPORT, CONN.

SPECIFICATION SCHEDULE "L."

			Stock in 1908	Specification Schedule "L."
Specific Gravity at 38° C.	1.103			
Distillation, Bulletin No. 65 Method.				
Up to 170° C.	Trace			No requirements.
170-225° C.	7.5%			
225-255° C.	3.7			
255-270° C.	1.9			
270-315° C.	14.6	27.7	32.3%	
315-360° C.	19.0	72.3	67.7%	
Above 360° C.	53.3			

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TABLE IX.—REFINED WATER-GAS TAR.

ROUTINE ANALYSIS OF STOCK TANKS.

	A	B	C	D	E	F	G	H	I	J
	1908	1909	1910	1911	1911	1912	1912	1913	1914	1915
Water	Trace	None	None	None	None	None	Trace	Trace	.6%	Trace
Specific Gravity at 77° F.	1.13	1.125	1.12	1.111	1.117	1.131	1.12	1.11	1.125	1.1359
Insoluble CS_2	0.9%	0.2%	0.6%	.....	0.8%	0.8%	1.3%	0.5%	1.0%	1.7%
Solid Naphthaline	Trace	0.2%	Trace	Trace	Trace	Trace	Trace	Trace	Trace	Trace
DISTILLATION										
To 170° C.	Trace	None	0.5%	3.2%	None	None	None	0.2%	0.39%	None
To 315° C.	32.3%	27.4%	27.1%	18.7%	23.9%	21.0%	27.0%	33.8%	26.19%	26.05%
To 315° C. +	67.7	72.6	72.4	78.1	76.1	79.0	73.0	66.0	73.42	73.95
Residue	Hard	Hard	Hard	Hard	Hard	Hard	Hard	Hard	Hard	Hard
DISTILLATE										
Sp. Gravity at 60° C., Fraction 255-315° C.		1.00	1.00	.....	.....	.....	0.995	.....	1.01	.....
Total Distillate Insoluble in Ethyl sulphate		None	None	None	None	None	None	None	None	None

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TABLE X.—REFINED WATER-GAS TAR.

Specific Gravity 38°/15.5° C.....	1.1100	1.1310	1.1400
Insoluble in Benzol & Chloroform.....	0.90%	0.90%	0.58%
Distillation:			
210° C.....	2.4	Trace	Trace
235° C.....	9.8	2.2	1.6
315° C.....	31.4	28.8	25.3
355° C.....	47.0	43.7	38.5
Specific Gravity of entire distillate 38°/15.5° C.....	0.9950	1.0050	1.0130

EFFECT OF ADDITION OF PETROLEUM OILS TO REFINED WATER-GAS TAR.

	Original Oil	+5%	+10%	Original Oil	+5%	+10%
Specific Gravity 38°/15.5° C.....	1.1108	1.0890	1.078	1.131	1.102	1.090
Insoluble in Benzol and Chloroform....	3.85	.....	.....	0.90	.....	.....
Distillation:						
210° C.....	Trace	Trace	0.0	Trace	0.0	0.0
235° C.....	3.2	0.7	1.0	2.2	2.5	3.0
315° C.....	20.2	23.6	25.2	28.2	29.9	30.6
355° C.....	41.3	45.0	46.7	43.7	46.1	46.7
Specific Gravity of Entire Distillate 38° 15.5° C.....	0.9952	0.9800	0.9690	1.005	0.9890	0.980

4. The distillates, based on water free oil, shall be within the following limits:

Up to 210° C., not more than 5%
Up to 235° C., not more than 15%
Up to 315° C., not more than 40%
Up to 355° C., not less than 25%

5. The specific gravity of the total distillate below 355° C., shall be not less than 0.99, nor more than 1.02 at 38° compared with water at 15.5° C.

6. The foregoing tests shall be made in accordance with the standard methods of the American Wood-Preservers' Association.

This specification is one that has been in use for eight years, and covers the preservative that was used in the treatment of the blocks described in this report.

Table IX shows the average analysis of the stock tanks which cover the oil during the various years in the treatment of the blocks inspected.

This specification is essentially the same as that submitted to the American Society for Municipal Improvements, but it has been changed in its wording to make it uniform with those reported by the other Sub-Committee for adoption.

Your Sub-Committee has attempted, in drawing up this specification, to secure by definition and by requirements a refined water-gas tar. It believes that the gravity of the distillate specified would exclude the presence of any considerable quantity of petroleum oils.

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Your Sub-Committee submits, in Table X; analyses showing the character of refined water-gas tar that would probably be met with under this specification, and also analyses showing the effect of the addition of certain percentages of petroleum oils on the gravity of the distillate.

If the General Committee deems it advisable, the members of your Sub-Committee would be glad, either acting alone or in cooperation, to continue this work and present further data regarding the use of water-gas tar either wholly or in part of the treatment of wood block for paving purposes.

Exhibit "A."

SPECIFICATION "A." The preservative shall be a product of coal-gas, water-gas, or coke-oven tar, which shall be free from all adulterations, and shall contain no raw or unfiltered tars, petroleum compounds, or tar products obtained from processes other than those stated.

a. SPECIFIC GRAVITY. The specific gravity shall be not less than 1.08 nor more than 1.14 at a temperature of 38° C.

b. SOLUBILITY. Not more than 3½% shall be insoluble by continuous hot extraction with benzol and chloroform.

c. Distillate. On distillation, which shall be made exactly as described in Bulletin No. 65 of the American Railway Engineering Association, the distillates based on water-free oil, shall not exceed ½% at 150° C., and shall be not less than 30% nor more than 40% at 315° C. The specified distillation test requires the use of a glass retort of approximately 8 ozs. capacity, connected with a tube and bottle placed a maximum distance of 24 ins. from the center of the retort. A mercury thermometer in the retort shall be placed ½ in. above the oil, which shall be exactly 100 grams in quantity. The distillation shall be continuous and should be completed in about 45 minutes.

d. CONTAINED WATER. The preservative shall contain not more than 3% of water.

Exhibit "B."

CHARACTER OF OIL. The oil with which the blocks are to be treated shall be a stable antiseptic and water-proofing oil, from which the water has been removed by distillation, and which shall have a specific gravity of not less than 1.12 at 38° C.

When distilled in the manner hereinafter described, the oil shall lose not more than 35% up to a temperature of 315° C. The distillate between 255° and 315° C. shall have a specific gravity of not less than 1.00, the said specific gravity being taken at a temperature of 60° C.

METHOD OF TESTING OIL. One hundred grams of oil are weighed out into a glass retort, preferably made of Jena glass, having a capacity to bend of neck of 250 c.c. A condensing tube, air-cooled, is attached to the retort of such length that the total distance from the tubulure to the end of the condensing tube shall be approximately 60 c.m. The tubulure is fitted with a cork through which a nitrogen filled thermometer, registering to 400° C. and about 40 c.m. in length, is inserted in such a manner that the bottom of the bulb shall be ½ in. above the liquid at the time the distillation commences.

The distillation is made in a place free from draughts, and the retort is covered with asbestos paper and heated by the direct flame of an adjustable burner. The oil is warmed cautiously until any water that may be present is expelled. If water is present the amount is reported separately, all results being calculated on a dry-oil basis. The flame is then regulated in such a manner that the rate of distillation shall continuously be not slower than one drop per second, and not faster than two drops per second. The distillates are collected in weighed Erlenmeyer flasks.

The specific gravity of the fraction boiling from 255° to 315° C. is determined by means of a specific gravity bottle having a capacity of about 10 c.c. The oil previously warmed is poured into the bottle, which is then placed in a thermostat kept at 60° C. for one-half hour. The stopper is then inserted, the excess of oil

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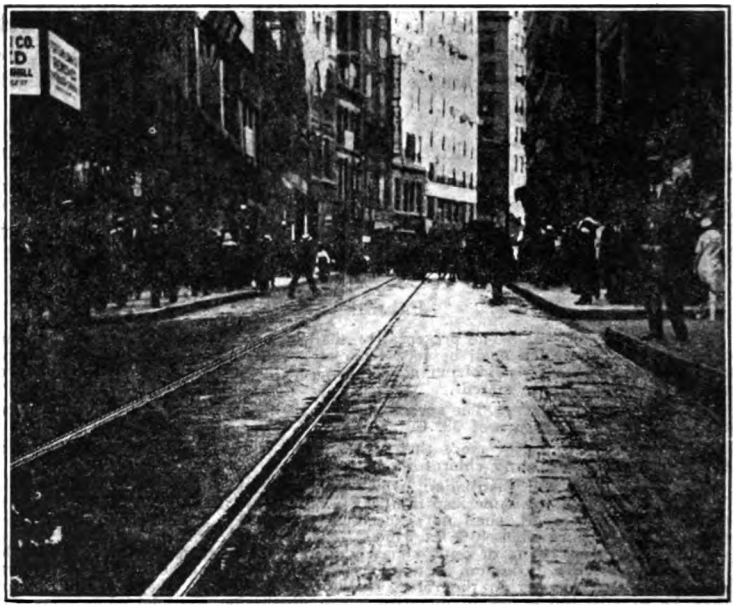

No. 1.—Washington St., from 78 Ft. south of Court Ave. to Cornhill and State Sts., Boston, Mass.
(Laid in 1908. Photographed Sept., 1916.)

wiped off, and after cooling the weight is obtained. This weight is compared with the weight of water at 60° C. which the same bottle contains.

INSPECTION AT THE WORKS. During the progress of manufacture and treatment of the paving blocks, the purchaser may designate—and maintain at his own expense—a representative who shall at all such times have full facilities afforded him by the manufacturer to inspect the timber, materials and methods used in the manufacture and treatment of the blocks.

Exhibit "C."

The antiseptic and water-proofing oil is to have a specific gravity of not less than 1.12 at 48° F. When distilled in a retort, with the thermometer suspended not less than 1 in. above the oil, it is to lose not more than 35% up to 315° C. The oil is to be free from any adulteration; it is not to be mixed or contain any foreign material.

Exhibit "D."

The antiseptic and water-proofing oil is to have a specific gravity of not less than 1.12 at 38° C. The oil is to contain not more than 5% of matter insoluble by continuous hot extraction with benzol and chloroform. The oil is to yield not more than 1% of distillate below 150° C. nor more than 25% below 315° C. when distilled in accordance with the method described in Bulletin No. 65 of the American Railway Engineering Association. The oil is to be free from petroleum or asphaltic residues.

Exhibit "E."

PRESERVATIVE. The preservative used shall be a product of coal-gas, water-gas, or coke-oven tar, which shall be free from all adulterations and contain no raw or unfiltered tars, petroleum compounds, or tar products obtained from processes other than those stated.

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The specific gravity shall be not less than 1.10 nor more than 1.14 at a temperature of 38° C.

Not more than 3½% shall be insoluble by continuous hot extraction with benzol and chloroform.

On distillation, which shall be made exactly as described in Bulletin No. 65 of the American Railway Engineering Association, the distillate, based on water-free oil shall not exceed ½% at 150° C., and shall be not less than 20% nor more than 40% at 315° C.

The oil shall contain not more than 3% of water.

The manufacturer of the blocks shall permit full and complete sampling at all times and places, and shall, if required, furnish satisfactory proof of the origin of the preservative.

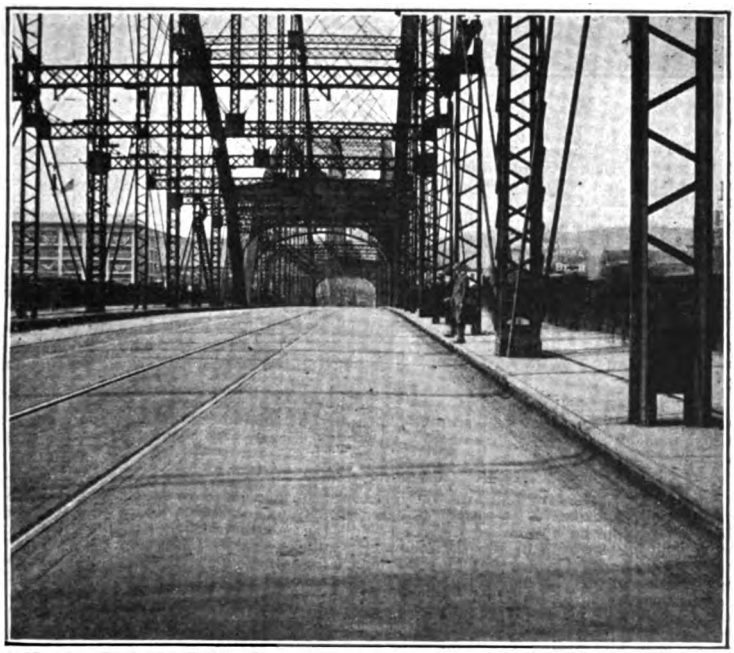
Samples of the preservative, taken from the treating tank during treatment, shall at no time show an accumulation of more than 2% of sawdust, dirt, or foreign matter. Due allowance shall be made for such accumulation of foreign matter by injecting an additional quantity of oil into the blocks.

Exhibit "F."

The preservative to be used shall be a product of coal-gas, water-gas, or coke-oven tar, which shall be free from all adulterations and contain no raw or unfiltered tars, petroleum compounds, or tar products obtained from processes other than those stated.

a. The specific gravity shall be not less than 1.10 nor more than 1.14 at a temperature of 38° C.

b. Not more than 3½% shall be insoluble by continuous hot extraction with benzol and chloroform.



No. 2.—Sixth St. Bridge Between Pittsburgh and Allegheny, Pittsburgh, Pa.
(Laid in 1908. Photographed Nov., 1916.)

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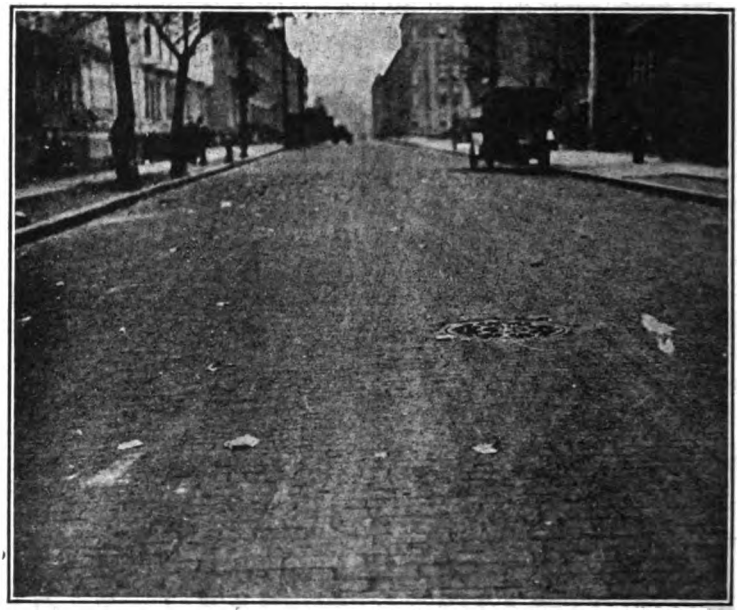

No. 3.—Charlotte St., Boston Road to Jennings, New York, N. Y.
(Laid in 1908. Photographed Oct., 1916.)

c. On distillation, which shall be made exactly as described in Bulletin No. 65 of the American Railway Engineering Association, the distillate, based on water-free oil, shall not exceed ⅛% at 150° C., and shall be not less than 30% nor more than 40% at 315° C.

d. The oil shall contain not more than 3% of water.

Exhibit "G."

The creosote oil is to conform to the following specifications when tested, as follows:

1. The specific gravity of the oil shall be at least 1.03 and not more than 1.10 at 38° C.

2. It shall be completely liquid at 25° C., and show no deposit on cooling at 22° C.

3. The oil shall be a pure coal-tar product or in the proportion of one-half water-gas tar, free from any adulteration; any petroleum oil or any product obtained from petroleum, and shall not contain more than 5% of matter insoluble in benzol.

The oil shall be subject to a distilling test as follows:

The apparatus for distilling the creosote must consist of a stoppered glass retort having a capacity, as nearly as can be obtained, of 8 ozs. up to the bend of the neck, when the bottom of the retort and the mouth of the offtake are in the same plane. The bulb of the thermometer shall be placed ½ in. above the liquid in the retort, and this position must be maintained throughout the operation. The bulb of the retort and at least 2 ins. of the neck must be and remain covered with a shield of heavy asbestos paper during the entire process of distillation, so as to prevent heat radiation, and between the bottom of the retort and the flame of the lamp or burner two sheets of wire gauze, each 20-mesh fine and at least 6 ins. square, must be placed. The flame must be protected against air currents.

Before beginning the distillation, 100 grams of the oil shall be placed in the retort. The thermometer shall be inserted in the retort, with the lower end of the

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bulb ½ in. from the surface of the oil, and the condensing tube attached to the retort by a tight cork joint. The distance between the bulb of the thermometer and the end of the condensing tube shall be 22 ins., and during the process of the distillation the tube may be heated to prevent the congealing of the distillates.

The distillates shall be collected in weighed bottles, and all percentages determined by weight in comparison with dry oil. The distillation shall be continuous and uniform, the heat being applied gradually, and shall take from 30 to 40 minutes after the first drop of distillate passes into the receiving vessel.

The total amount of distillate shall not exceed the following:

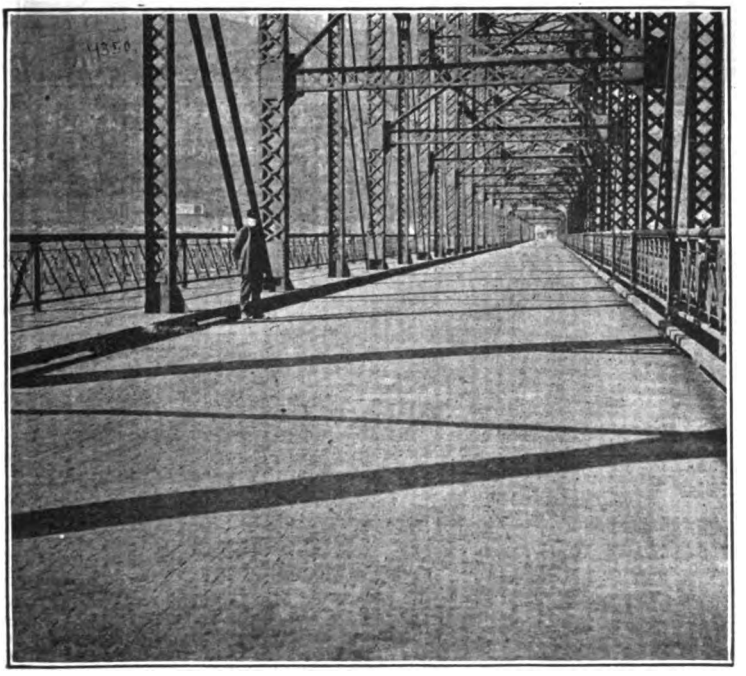
Up to 150° C., nothing must come off.
Up to 210° C., not more than 10% must come off.
Up to 235° C., not more than 35% must come off.
Up to 315° C., not more than 75% must come off.

Exhibit "H."

NEW YORK, BOROUGH OF BRONX, 1908.

TREATMENT. The blocks shall be treated as hereinafter specified with an antiseptic and water-proof mixture, substantially 75% of which shall be creosote or heavy oil of coal tar, conforming to the specifications hereinafter set forth; and 25% shall be resin, conforming to the said specifications; and not less than 26 lbs. of the mixture shall be injected in all blocks, except those made from longleaf yellow pine, which shall contain not less than 20 lbs. per cubic foot.

METHOD OF TREATMENT. Blocks cut from the several classes of timber allowed under these specifications will require different manipulation and treatment, and for this reason the exact methods of applying the mixture to the several timbers named will not be specified, it being understood that whatever method is used the process



No 4.—Oakmont, Pa., Bridge Floor.
(Laid in 1909. Photographed Nov., 1916.)

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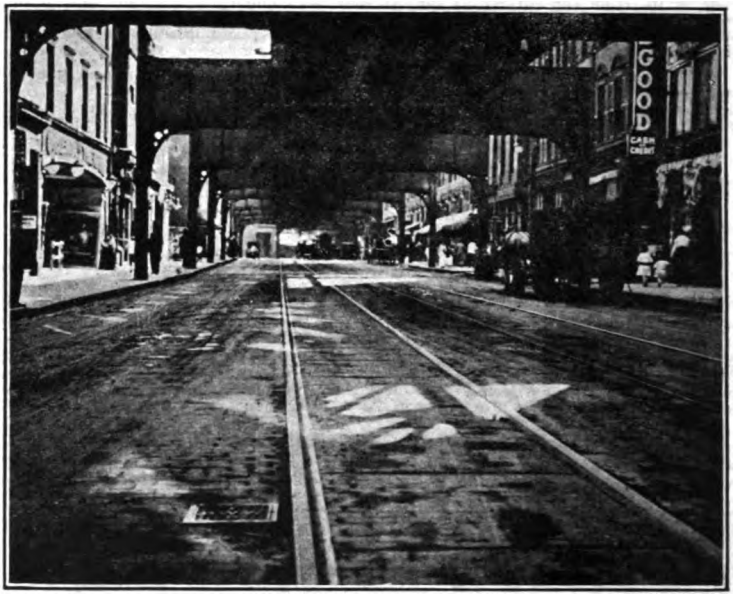

No. 5.—Washington St., Williams to Dudley St., Boston, Mass.
(Laid in 1911. Photographed Sept., 1916.)

must conform in every respect to the best and most advanced knowledge of the art, the purpose of the city being to allow the contractors to manufacture specification blocks by following any preferred detail, and by the use of any particular plan or machinery which may be properly adapted to secure the required results.

CREOSOTE. The creosote shall conform to the following specification when tested:

The specific gravity at 68° F. shall be not less than 1.12. When distilled in a retort with the thermometer suspended not less than 1 in. above the oil, it shall lose not more than 35% up to 565° F., and not more than 50% up to 665° F.

RESIN. The resin shall be solid, obtained from pine, and shall be incorporated with the creosote, heated sufficiently to melt the resin, in a suitable mixing tank until the proper mixture is secured.

Exhibit "I."

The antiseptic and water-proofing oil is to have a specific gravity of not less than 1.12 at 48° F. When distilled in a retort, with the thermometer suspended not less than 1 in. above the oil, it is to lose not more than 35% up to 315° C., and not more than 50% up to 370° C. The oil is to be free from adulteration; it is not to be mixed with or contain any foreign material.

Exhibit "J."

The antiseptic and water-proofing oil is to have a specific gravity of not less than 1.12 at 38° C. The oil is to contain not more than 5% of matter insoluble by continuous hot extraction with benzol and chloroform. The oil is to yield not more than 1% of distillate below 150° C., or more than 25% below 315° C., when distilled in accordance with the method described in Bulletin No. 65 of the American Railway Engineering Association. The oil is to be free from petroleum or asphaltic residue.

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Exhibit "K."

PRESERVATIVE. The preservative shall be a product of coal-gas, water-gas, or coke-oven tar, which shall be free from all adulterations and contain no raw or unfiltered tars, petroleum compounds, or tar products obtained from processes other than those stated.

The specific gravity shall be not less than 1.10 nor more than 1.14 at a temperature of 38° C.

Not more than 3½% shall be insoluble by continuous hot extraction with benzol and chloroform.

On distillation, which shall be made exactly as described in Bulletin No. 65 of the American Railway Engineering Association, the distillate, based on water-free oil, shall not exceed ½% at 150°C., and shall be not less than 20% nor more than 40% at 315° C.

The oil shall contain not more than 3% of water.

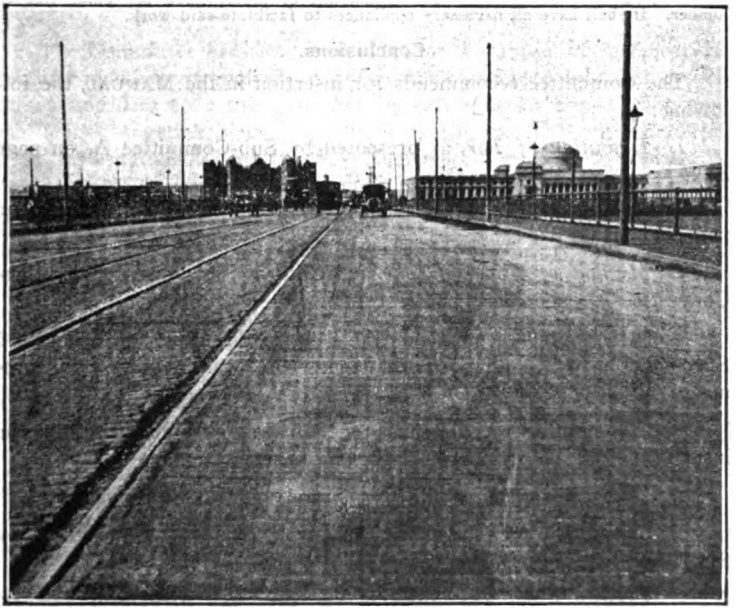
The manufacturer of the blocks shall permit full and complete sampling at all times and places, and shall, if required, furnish satisfactory proof of the origin of the preservative.

Samples of the preservative, taken from the treating tank during treatment, shall at no time show an accumulation of more than 2% of sawdust, dirt or other foreign matter. Due allowance shall be made for such accumulation of foreign matter by injecting an additional quantity of oil into the blocks.

Exhibit "L."

WOOD BLOCK SPECIFICATIONS, CITY OF BRIDGEPORT, CONN.

The blocks shall be made from Southern yellow pine, and shall be free from unsoundness, shakes, or cracks or other defects which might impair the durability of the pavement. The annual rings shall average eight to the inch, but in no case shall be less than four to the inch measured radially.



No. 6.—East Cambridge, Mass., Howard Bridge.
(Laid in 1912. Photographed Sept., 1916.)

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The blocks shall be carefully sawed from 5 to 8 ins. long, 3½ ins. in depth, and 3 ins. in width. All blocks in one street shall be of uniform width.

The variation of 1/16 in. in depth and ⅛ in. in width of the blocks will be allowed.

The blocks shall be thoroughly seasoned by natural or artificial means, or methods which will insure the removal of all moisture, obviate checking and cracking, and shall be thoroughly impregnated with an antiseptic or preservative and water-proofing substance. Whatever process of seasoning be utilized, the blocks shall be completely deprived of all moisture as an absolute essential before final preservative and water-proofing treatment. No method will be allowed by which the checking of the blocks may not be entirely avoided. No particular method or treatment is required, it being understood that any method may be employed which may be adapted to the facilities and appliances of any properly equipped creosoting works, and which will insure the results required by these specifications.

The paving blocks when impregnated with the preservative shall contain at least 16 lbs. of preservative per cubic foot of wood.

The result required is a block whose pores are entirely free from moisture and thoroughly permeated by an antiseptic fluid, and rendered water-proof.

Sawdust from the treated blocks shall be extracted with benzol, and the extract distilled and tested.

Sample blocks taken at random when sawed or split through the middle shall show the treatment throughout, proper allowance being made for the impermeability of sound knots.

Treated blocks dried in an oven for 24 hours, or until they cease to lose weight, at a temperature of 120° F.; weighed in air and immersed in water for 24 hours, and again weighed, shall not show a gain in weight of more than 4½ %.

The bidders will state the method of treatment and furnish to the Commission samples of the preservative used in treatment.

The material to be used as well as the finished treated blocks, will be subject to inspection at the plant as well as at the site of the work by the Engineer, or a representative of the Commission. The plant shall be provided with proper means of obtaining absolute measurement of amount of preservative per cubic foot of lumber. It shall have all necessary appliances to facilitate said work.

Conclusions.

The Committee recommends for insertion in the MANUAL, the following:

1. *Definition of Tar,* as presented by Sub-Committee A, on page 280.

2. *Definition of Creosote,* as presented by Sub-Committee A, on page 280.

3. *Method of Analysis for Zinc Chloride,* as presented by Sub-Committee A, page 280.

The Committee recommends the repeal of the previously adopted Specification for Standard Thermometer, as presented by Sub-Committee A, on page 282.

The Committee recommends for adoption as standards and for insertion in the MANUAL the following specifications:

1. *Zinc Chloride* as proposed by Sub-Committee C, on page 326.

2. *Creosote for Ties and Structural Timber,* as proposed by Sub-Committee B, on page 307.

3. *Creosote-Coal Tar Solution for Ties and Structural Timber,* as proposed by Sub-Committee B, on page 307.

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4. *Coal-Tar Oil for Paving Blocks,* as proposed by Sub-Committee B, on page 308.

5. *Distillate Oil for Paving Blocks,* as proposed by Sub-Committee B, on page 308.

The Committee recommends for adoption as standard and for insertion in the MANUAL the following methods of analysis:

1. *Determination of Amount of Water,* as proposed by Sub-Committee B, on page 309.

2. *Determination of Amount Insoluble in Benzol,* as proposed by Sub-Committee B, on page 310.

3. *Determination of Specific Gravity,* as proposed by Sub-Committee B, on page 312.

4. *Distillation Test,* as proposed by Sub-Committee B, on page 313. (This includes a new specification for a thermometer).

5. *Determination of the Specific Gravity of Fractions,* as proposed by Sub-Committee B, on page 316.

6. *Float-Test,* as proposed by Sub-Committee B, on page 319.

7. *Determination of the Coke Residue,* as proposed by Sub-Committee B, on page 320.

The Committee presents as information a number of specifications for and methods of analysis of preservatives adopted by other associations, and data concerning the use of water-gas tar for treating paving blocks, together with a tentative specification for this material. This information is contained in the report of Sub-Committee A, on pages 283 to 306 and in the report of Sub-Committee D, on pages 48 to 55.

Recommendations for Future Work.

The Committee suggests for future work:

1. Continue the study of methods of sampling zinc chloride and creosote.

2. Continue the study of some of the tests for creosote, particularly the float-test, and the coke-test.

3. Report for information more detailed tests for differentiating between coal-tar oils, and water-gas-tar oils.

4. Continue the investigation of the use of water-gas tar products as wood-preservatives.

5. Begin a study of wood-preservatives other than zinc chloride and creosote.

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6. Investigate methods for determining the quantity and quality of preservative in treated timber.

E. B. FULKS, *Chairman*
S. F. ACREE
S. R. CHURCH
C. N. FORREST
W. H. FULWEILER
A. L. KAMMERER
O. C. STEINMAYER
C. M. TAYLOR

APPENDIX TO REPORT OF SUB-COMMITTEE B OF COMMITTEE ON PRESERVATIVES.

In this appendix data are submitted, showing:

(1). Tests of oils with particular reference to the use of the float test and the coke test; and

(2.) Tests of oils with particular reference to the value of the determination of specific gravity of fractions.

1.—Float Test and Coke Test.

Table 1 gives comparative tests made in the laboratories of several members of the Committee, on samples of oils prepared in one laboratory and sent to the other laboratories.

Table 2 consists of tests made in the laboratory of one member of the Committee on a rather comprehensive range of distillate oils and creosote-coal tar solutions received in the regular course of inspection of oils.

Table 3 gives tests made in the laboratory of a member of the Committee, illustrating the value of the float test on a creosote-coal tar solution and a coal-tar paving oil.

2.—Specific Gravity.

Table 4 gives tests made in the laboratory of one member of the Committee, showing the effect on the specific gravity of fractions when different percentages of water-gas tar are added to coal-tar paving oil.

Table 5 gives tests made in the laboratory of another member, showing the effect on specific gravity of fractions when different percentages of water-gas tar are added to creosote oil.

Tables 6 and 7 give tests made in the laboratory of a third member of the Committee, showing the effect of adding different percentages of water-gas tar from several sources to coal-tar paving oils.

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TABLE 1.—COMPARATIVE TEST MADE IN LABORATORIES OF SEVERAL MEMBERS OF COMMITTEE ON SAMPLES OF OILS PREPARED IN LABORATORY "C" AND SENT TO OTHER LABORATORIES.

Test	Laboratory	1	2	3	4	5	6	7	8	9	10
		CREOSOTE-COAL TAR SOLUTIONS.				COAL-TAR PAVING OILS.					
		Contains 20% Filtered Coal Tar	30% Filtered Coal Tar for Comparison with No. 1	20% Filtered Coal Tar	30% Filtered Coal Tar for Comparison with No. 3	35% Filtered Coal Tar	45% Filtered Coal Tar for Comparison with No. 5	35% Filtered Coal Tar	45% Filtered Coal Tar for Comparison with No. 7	Distillate Oil for Paving Blocks	Creosote Oil for Ties
Sp. Gr. at 38° C.	A	1.098	1.104*	1.074	1.088	1.107	1.112	1.088	1.088	1.088	1.072
	B	1.097	1.101*	1.073	1.086	1.105	1.109	1.089	1.104	1.087	1.070
	C	1.098	1.104*	1.073	1.088	1.105	1.110	1.088	1.106	1.088	1.070
	D	1.097	1.101*	1.074	1.087	1.105	1.111	1.088	1.106	1.086	1.070
Per Cent. Distilling Below 235° C.	A	10.4	10.0	20.4	17.6	9.9	9.1	16.8	10.9	12.7	24.3
	B	9.5	8.3	16.7	12.8	6.4	6.1	13.2	9.1	10.2	22.4
	C	9.0	8.1	20.1	15.5	7.8	6.8	14.8	8.8	10.8	22.1
	D	9.0	8.4	17.9	14.6	11.6	11.0	12.6	10.3	13.4	21.7
Sp. Gr. of Fraction 235-315° C.	A	1.037	1.037	1.030	1.030	1.030	1.037	1.036	1.035	1.043	1.042
	B	1.032	1.032	1.031	1.031	1.032	1.033	1.028*	1.033	1.030	1.034
	C	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	D	1.033	1.038	1.029	1.033	1.038	1.040	1.029	1.036	1.038	1.038
Sp. Gr. of Fraction 315-355° C.	A	1.112	1.109	1.100	1.109	1.114	1.113	1.108	1.101	1.118	1.121
	B	1.100	1.110	1.103	1.103	1.102	1.096*	1.087*	1.096*	1.102	1.115
	C	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	D	1.100	1.102	1.102	1.108	1.105	1.102	1.098	1.104	1.109	1.102
Per Cent. Residue at 355° C.	A	37.3	38.1	25.5	30.5	37.0	39.0	30.7	38.0	34.0	22.0
	B	41 0	42.0	31.0	34.5	42.5	46.0	34.5	41.0	39.0	27.5
	C	39.0	38.4	26.8	30.9	39.8	40.0	32.1	38.3	37.3	26.0
	D	39.6	40.5	26.8	31.2	40.0	40.8	32.0	38.5	37.0	26.2
	E	35.7	37.0	24.6	29.8	37.4	30.3	31.3	37.8	32.7	33.4
Float Test at 70° C (Seconds)	A	28	40	44	64*	60	92*	125	129*	40	40
	B	24	30	48	30(?)	44	48	92	85*	20	27
	C	38	47	44	69*	64	109*	97	117*	.....	.....
	D	34	40	43	55*	50	72	92	101*	22	24
	E	42	56	52	78*	65	110*	108	137*	35	37
Per Cent. Coke Residue	A	5.4	6.4*	3.9	4.1	6.8	9.0	7.6	8.6	1.3	0.8
	B	5.0	7.3*	5.0	6.2	7.7	11.3*	9.2	10.8	1.1	1.0
	C	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	D	.....	5.1	5.1	5.4	8.8	9.9	8.9	8.1	1.8	1.3
	E	4.2	5.7	3.8	5.4	5.2	8.5	6.5	8.9	1.0	0.9

*Indicates failure to meet requirement of specification.

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TABLE NO. 2.—TESTS OF VARIOUS OILS MADE IN LABORATORY "B."

Kind of Oil	Sp. Gr. at 38° C.	DISTILLATION Distillate Below 235° C.	DISTILLATION Residue Above 355° C.	Sp. Gr. Fractions at 38/15.5° C. 235-315	Sp. Gr. Fractions at 38/15.5° C. 315-355	Float Test Sec. at 70° C.	Coke Residue
		Per Cent.	Per Cent.				
Distillate Creosote Oil (American)..	1.105	0.7	51.7	1.039	1.096	32.0	0.4
" " " (English)...	1.041	24.1	13.8	1.027*	1.087*	35.0	1.8
" " " "	1.050	11.1	14.5	1.016*	1.079*	....	..
" " " (American)..	1.079	15.8	18.5	1.045	1.117	46.5	1.4
" " " "	1.090	1.2	23.5	1.040	1.108	36.5	(?)3.5*
" " " "	1.086	9.7	22.0	1.042	1.106	32.0	0.8
" " " "	1.070	22.4	27.5	1.034	1.115	27.0	1.0
" " " "	1.087	10.2	39.0	1.030	1.102	20.0	1.1
80-20 Creosote-Coal Tar Solution...	1.069	13.5	21.0	1.031	1.094	11.5	6.2
" " " " " ...	1.100	....	31.0	1.041	1.110	21.0	5.1
" " " " " ...	1.095	14.0	29.0	1.042	1.104	25.0	4.5
" " " " " ...	1.100	7.7	33.0	1.042	1.120	28.0	4.6
" " " " " ...	1.097	9.5	41.0	1.032	1.100	25.0	5.0
" " " " " ...	1.073	16.7	31.0	1.031	1.103	48.0	5.0
65-35 Paving Oil.....	1.111	....	38.0	1.040	1.106	34.0	10.4
" " "	1.105	6,4	42.5	1.032	1.102	44.5	7.7
" " "	1.089	13.2	34.5	1.028	1.087	92.5	9.2

*Indicates failure to meet requirement of specification.

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TABLE 3.—TESTS ILLUSTRATING THE VALUE OF THE FLOAT TEST.
(Made in Laboratory "D").

TEST	CREOSOTE-COAL TAR SOLUTION		COAL-TAR PAVING OIL	
	Contains 20% Filtered Coal Tar	Contains 23% Filtered Coal Ttar	Contains 35% Filtered Coal tar	Contains 40% Filtered Coal Tar
Water, Per Cent	0.3	0.4	trace	trace
Insoluble in Benzol, Per Cent	0.7	0.6	1.4	1.5
Specific Gravity at 38° C.	1.098	1.100	1.106	1.111
Retort Distillation: 170° C.	0.3	0.5	.....	.....
200° C.	0.5	0.7	0.4	.....
210° C.	1.4	1.5	0.9	0.6
235° C.	17.9	15.0	8.0	9.7
270° C.	36.3	35.5	25.0	25.2
315° C.	48.3	48.3	41.4	40.0
355° C.	63.4	64.7(?)	62.6	61.4
Specific Gravity of Fraction 235-315° C. at 38/15.5° C.	1.038	1.034	1.038	1.042
Specific Gravity of Fraction 315-355° C. at 38/15.5° C.	1.101	1.105	1.104	1.098
Residue Above 355° C., Per Cent	36.2	34.8(?)	37.0	37.4
Residue Above Float at 70° C., Sec.	44.4-46.8	64.8-66*	64.8-67.8	85.2-85.8*
Coke Residue, Per Cent	5.2	5.5	6.7	7.8

*Indicates failure to meet requirement of specification.

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TABLE 4.—TEST SHOWING EFFECT ON SPECIFIC GRAVITY OF FRACTIONS WHEN WATER-GAS TAR IS ADDED TO COAL-TAR PAVING OIL.

(Made in Laboratory "C").

TEST	65% Distillate Oil 30% Water-Gas Tar 5% Coal Tar	65% Distillate Oil 20% Water-Gas Tar 15% Coal Tar	65% Distillate Oil 10% Water-Gas Tar 25% Coal Tar	50% Distillate Oil 50% Water-Gas Tar
Water, Per Cent.....	0.1	0.1	0.1	0.1
Insoluble in Benzol, Per Cent.....	0.7	1.3	1.9	.....
Specific Gravity at 38° C.....	1.080	1.087	1.095	1.077
Retort Distillation: 200° C.....	0.4	0.3	0.2	0.6
210° C.....	2.3	1.9	2.0	2.4
235° C.....	17.8	17.6	16.9	16.6
315° C.....	51.4	49.3	47.1	47.8
355° C.....	65.1	63.7	61.0	62.9
Specific Gravity of Fraction 235-315° C. at 38/15.5°C.....	1.027*	1.028*	1.028*	1.019*
Specific Gravity of Fraction 315-355° C. at 38/15.5°C.....	1.093*	1.099*	1.102	1.083*
Residue Above 355° C., Per Cent.....	34.2	35.6	38.2	36.4
Residue Above Float at 70° C., Sec...	58	60	65	.....

*Indicates failure to meet requirement of specification.

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TABLE NO. 5.—TESTS SHOWING EFFECT ON SPECIFIC GRAVITY OF FRACTIONS WHEN WATER-GAS TAR IS ADDED TO COAL-TAR CREOSOTE OIL.

(Made in Laboratory "A").

TEST	Creosote Oil	Creosote Oil Plus 10% Water-Gas Tar	Creosote Oil Plus 25% Water-Gas Tar
Specific Gravity at 38° C.....	1.045	1.048	1.052
Distillation to 235° C.....	28.4	27.6	26.6
Distillation to 315° C.....	73.2	71.4	68.6
Residue at 355 °C.....	13.5	12.5	16.0
Specific Gravity of Fraction 235/315° C.....	1.034	1.033	1.024*
Specific Gravity of Fraction 315/355° C.....	1.106	1.088*	1.082*
Coke Residue, Per Cent.....	0.9	3.43	4.46
Float Test on Residue at 355° C., at 70° C., Sec.....	24-25-26	64-62-66	147-137

*Indicates failure to meet requirement of specification.

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TABLE 6.—TESTS SHOWING EFFECT ON SPECIFIC GRAVITY OF FRACTIONS WHEN WATER-GAS TAR IS ADDED TO COAL-TAR PAVING OIL.

(Made in Laboratory "D").

(Three Grades of Water-Gas-Tar Used).

Mixture		Specific Gravity of Fraction	
		235-315° C.	315-355° C.
Water-Gas Tar.....X Creosote Oil..... Coal Tar.....	15% 65% 20%	1.031	1.094*
Water-Gas Tar.....X Creosote Oil..... Coal Tar.....	25% 65% 10%	1.029*	1.088*
Water-Gas Tar.....X Creosote Oil.....	40% 60%	1.027*	1.081*
Water-Gas Tar.....Y Creosote Oil..... Coal Tar.....	15% 65% 20%	1.033	1.085*
Water-Gas Tar.....Y Creosote Oil.....	35% 65%	1.029*	1.080*
Water-Gas Tar.....Z Creosote Oil.....	35% 65%	1.033*	1.081*

*Indicates failure to meet requirement of specification.

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TABLE 7.—TESTS SHOWING EFFECT ON SPECIFIC GRAVITY OF FRACTIONS WHEN WATER-GAS TAR IS ADDED TO COAL-TAR PAVING OIL.

(Made in Laboratory "D").

(Two Grades of Creosote Oil Used).

TEST	65% Creo. A 20% Coal Tar 15% W.-G. Tar	65% Creo. A 10% Coal Tar 25% W.-G. Tar	65% Creo. A 35% W.-G. Tar	65% Creo. B 20% Coal Tar 15% W.-G. Tar	65% Creo. B 10% Coal Tar 25% W.-G. Tar	65% Creo. B 35% W.-G. Tar
Water, Per Cent	0	0	0	0	0	0
Insoluble in Benzol, Per Cent	2.8	2.6	1.9	2.5	2.3	2.0
Specific Gravity at 38° C.	1.087	1.083	1.087	1.122	1.127	1.129
Retort Distillation: 170° C.	0	0.2	0	0	0	0
200° C.	0.1	0.8	0.1	0.3	0.4	0.2
210° C.	1.2	1.6	0.9	0.6	0.6	0.4
235° C.	18.5	19.4	16.4	4.0	3.5	2.7
315° C.	55.2	54.9	53.3	33.3	32.5	30.9
355° C.	67.8	68.5	66.8	54.8	54.2	53.0
Specific Gravity of Fraction 235-315° C. at 38/15.5° C.	1.020*	1.024*	1.026*	1.041	1.038	1.039
Specific Gravity of Fraction 315-355° C. at 38/15.5° C.	1.096*	1.097*	1.087*	1.111	1.106	1.104
Residue Above 355° C., Per Cent	31.9	30.8	32.5	44.5	45.3	46.3
Residue Above Float at 70° C., Sec.	132*	375*	477*	54.6	65	81*
Coke Residue, Per Cent	9.4	10.3*	12.2*	9.3	10.4*	10.7*

*Indicates failure to meet requirement of specification.

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DISCUSSION OF REPORT OF SUB-COMMITTEE B OF COMMITTEE ON PRESERVATIVES.

By Ellis R. Dutton.

In the report of Sub-Committee B on page 307 of Committee on Preservatives, I notice that the specific gravity of the fraction 235° to 315° is raised to 1.03; and of fraction 315° to 355° to 1.10. The original specification was 1.02 and 1.09, respectively. Also on page 309, under "Distillate Oil," section 5, the same raise has been made. I do not see any necessity for this change in gravity, and surely, if the report of the Committee is to be taken as a whole, there is no necessity for this change, as from the reading of the report the water-gas-tar oil has given nearly as good results as the coal-tar oil, and the only reason for these changes in gravity, or for this section at all, is to prevent the use of a considerable quantity of water-gas tar.

The report of the Committee on Preservatives is very full and complete, and it is the best report I have seen along these lines, and especially it is very pertinent at this time to have a report on the use of water-gas tar, as the claims have been made by the producers of water-gas tar that it was almost as good, if not as good, a preservative as the coal-tar products.

From the investigation of this Committee it would appear that water-gas tar has given excellent results as a preservative in creosoted wood block work.

I am glad, indeed, that the various Committees of these societies are getting together on a standard specification for creosoted wood-block paving, one upon which the various manufacturers can agree, and which should be satisfactory to the purchasers.

I wish to thank the Committee for these excellent reports.

DISCUSSION OF REPORT OF COMMITTEE ON PRESERVATIVES.

By Wm. A. Fisher.

We have examined the report of the Committee on Preservatives with much interest and appreciation of the large amount of work accomplished and the excellent manner in which it is presented.

We are glad to note that for straight distillate oils there has been no let-down in the proposed specifications, which are in some respects even more stringent than those of the American Railway Engineering Association for Grade 1 oil, now generally considered as standard.

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In our dealings with the English distillers we have constantly endeavored to raise the grade of their product, and we are convinced that any retrogression whatever in the standards on this side would result in the loss of such success as we may have had in improving the quality of the English imports. The adoption of the American Railway Engineering Association standard some years ago did much to convince the English tar distillers that the American market demanded the highest grade of creosote, and if for no other reason therefore, we should be glad to see the present standards maintained.

In considering the question of specifications broadly, however, the commercial situation cannot be ignored. No matter how high may be our ideals in the matter of specifications and preservatives, we cannot lose sight of the fact that the war and the conditions resulting from it have cut off the important German oils from our market, and that while fortunately the English supplies have continued to come over with fair regularity, there is by no means any definite assurance that the latter also may not be cut off, and the industry left entirely dependent on the domestic production until hostilities cease.

In fact, our latest advices from the other side bring the disagreeable news that the British Government has given notice of its intention to commandeer for fuel purposes, presumably for the term of the war, quantities of English oil in amounts not yet announced, but said to be from 70,000 tons upwards. We are still hoping that a certain proportion of it may continue available for the American market. Should imports from this source continue undisturbed, however, there still remains the fact that some of the English oil does not fully meet all the requirements of the specifications proposed, particularly Clause 4, defining the limits which may distill off up to 235° C.

Now, 35 to 40% of last year's supply in this country came from England, and we believe that all grades of this oil will continue in demand as heretofore, for there is certainly not enough Grade 1 oil available to satisfy all consumers. If this is so, and we doubt that the statement can be seriously questioned, why not meet the situation squarely and adopt an additional specification similar to the Grade 2 A. R. E. A. specification?

The committee has touched on this point in the footnote on page 42. We should like to see it go further and present an additional specification so that uniformity and definiteness will be assured for the consumers who might buy these oils from choice or necessity, and we cannot see that such action would impair the effectiveness of the standard specification.

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DISCUSSION OF THE PAVING-OIL SPECIFICATION PROPOSED BY THE JOINT COMMITTEES OF THE AMERICAN SOCIETY FOR TESTING MATERIALS, AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS, SOUTHERN PINE ASSOCIATION, AMERICAN SOCIETY OF CIVIL ENGINEERS, AND THE AMERICAN WOOD-PRESERVERS' ASSOCIATION.*

By E. Bateman,

Chemist in Forest Products, Forest Service.

The specification for paving-block oil proposed by the joint meeting at Brooklyn, N. Y., in September, 1916, of the committees on paving blocks for the American Society for Testing Materials, the American Society of Municipal Improvements, the Southern Pine Association, the American Society of Civil Engineers, and the American Wood-Preservers' Association attempts to limit the amount of tar in tar solutions by the use of the coke test and "float test" and to guarantee the purity of the distillable portion by limiting the specific gravity of the two highest fractions. The coke test and float test will, in all probability, limit the amount of tar in solutions just so long as only coal tar is used. If, however, water-gas tar is added in place of coal tar, amounts up to 50% can be used without exceeding the limit set for the coke test and float test and, in certain cases, without falling below the limits, 1.020 and 1.090, set for the specific gravity of the fractions, 235° to 315° and 315° to 355°, respectively.†

The United States produces between 50,000,000 and 60,000,000 gals. of water-gas tar per annum, about one-third of which (it is conservatively estimated) could be used in tar solutions in this manner. The wood-preserving industry used in 1914 approximately 9,500,000 gals., and in 1915 approximately 3,000,000 gals. of paving oil (Proceedings of American Wood-Preservers' Association, 1916). There is, therefore, considerably more water-gas tar available for use in coal tar solutions than the total amount of paving oil used in both years combined.

The following experimental work was undertaken with a view of determining just how much water-gas tar could be added to coal tar without exceeding the limits laid down by this specification.

Coke Residue.

The coke residue on a number of tars was obtained in the following manner:

*Presented to the Committee on Preservatives, American Wood-Preservers' Association, at their meeting in Cleveland, Nov. 14, 1916.

†The Committee raised the specific gravity of the fraction 235° to 315° C. from 1.020 to 1.030 and the specific gravity of the fraction 315° to 355° from 1.09 to 1.10.

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Two-gram samples of tar were accurately weighed into 35 mm. porcelain crucibles, tall form, covered with a 37 mm. porcelain crucible, low form. The crucibles were then gently heated until all the volatile matter had been expelled and were then exposed to the full flame of a Bunsen burner until the outside had been thoroughly burned free from carbon. They were then cooled in a desiccator and weighed. Duplicate samples were run, a difference of 10% of the coke residue being considered a check result. The figures given in the following table are the average of two or more determinations. The free carbon or matter insoluble in benzol was determined by the method proposed by the American Society for Testing Materials, 1916.

(Owing to the viscosity and, in some cases, the high carbon content of the tars, the bulb used in the N. E. L. A. test could not be used. The results here recorded may differ somewhat from those which might have been obtained if the bulb could have been used. It is believed, however, that if anything the results may be slightly too high, but the error must be small since the author has been able to calculate with reasonable accuracy the coke residue of solutions, using these figures as a basis.)

TABLE 1.

Kind of tar.	Tar no.	Free carbon content.	Coke residue.	Bituminous coke residue.
High or Medium Free Carbon.	1	37.1	57.2	20.1
	2	18.6	43.5	24.9
	3	16.2	42.9	26.7
	4	15.4	34.4	19.0
Low Carbon Coal.	5	7.6	26.8	19.2
	6	6.7	27.0	20.3
	7	5.4	28.4	23.0
	8	5.2	30.6	25.4
	9	4.4	29.4	25.0
Water-Gas.	10	1.3	25.3	24.0
	11	1.1	28.1	27.0
	12	.1	23.2	23.1
	13	..	18.2	18.2

It is to be noted that there is a considerable variation in the coke residue being higher in those tars with a high carbon content and lower in water-gas tars. It is to be noted further that if the percentage of insoluble matter in benzol be subtracted from the percentage of coke residue a figure is obtained which, for want of a better term, we will call "bituminous coke residue." This bituminous coke residue is nearly constant for all three classes of tar shown in Table 1.

A coke residue of 10% will, according to the above figures, admit from 33 to 37% of low carbon tar, but may admit from 35 to 50% of water-gas tar. In other words, the coke residue as it stands at present gives an incentive for the substitution of water-gas tar for coal tar, since more of the former can be added and still fulfill the coke test. If, however, the wording of the specification be changed to read:

"Material insoluble in benzol shall not exceed 3% and the bituminous coke residue (that is, the percentage of coke residue minus the percentage of matter insoluble in benzol) shall not exceed 7%."

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then it will restrict the coal tar to about the same limits (28 to 37%) and the water-gas tar to from 26 to 39%, or, in other words, it will limit the two classes of tar to about the same amount instead of favoring water-gas tar.

Specific Gravity of Fractions.

The specific gravity of the fractions of creosote will, of course, vary to some extent with the percentage composition of the creosotes. They will also vary with the tars from which they were produced. In general, those tars which were formed at high temperatures, produce creosotes whose fractions have high specific gravities, and those tars produced at lower temperatures have somewhat lower gravities.

In some previous work on the properties of coal-tar creosotes and water-gas tar distillates, this Laboratory [Forest Products Laboratory] had occasion to collect approximately 50 tars from all sections of the country and from all types of retorts and coke ovens. From these tars three have been selected, from which creosotes have been produced in the Laboratory. One of these tars yields fractions whose specific gravity is the highest of the entire collection; another is about the average, while the third has a low specific gravity. The distillation of these oils and the specific gravity of their fractions are shown in Table 2.

TABLE 2.

Mixture Contains.	Distillate Up to				Sp. Gr.—38/15	Sp. Gr.—38/15
	210°	235°	315°	355°	235° to 315°	315° to 355°
Creosote No. 1 (High Gravity).....	..	18.3	65.1	87.0	1.047	1.145
Creosote No. 2 (Average Gravity)..	1.6	21.6	73.7	91.9	1.036	1.112
Creosote No. 3 (Low Gravity).....	1.9	18.3	70.1	88.9	1.025	1.108

It is interesting to note that all of the tar solutions except Nos. 1 and 4 passed all the specifications for the American Society for Municipal Improvements, except that they are not pure coal-tar products. They contain anywhere from 15 to 35% of water-gas tar, and from 35 to 50% of total tar.

Out of a total of five solutions containing 40, 45, 45, 50, and 50% of total tar, one containing 35% water-gas tar and 15% coal tar is eliminated by the coke test, and probably by the float test. One (containing 45% water-gas tar) passes the coke test, but is thrown out by the float test. In both these cases, if the creosote oil had been lower boiling, the float test would not have been applied since the residues on distillation up to 355° C. were 36.4 and 35.5%, respectively. The other three solutions, containing 40, 45 and 50% of total tar, respectively, are admitted since the residue on distillation up to 355° C. is less than 35% (viz., 21, 24, 31%, respectively).

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TABLE 3—ANALYSIS OF TAR SOLUTIONS.

No.	Tar Solution. Composition of	Sp. Gr.	Carbon. Free	Residue. Coke	Residue Bit. Coke	210° Distillates	235° Distillates	315° Distillates	Up to 355°	Residue.	Sp. Gr. 235-315°	Sp. Gr. 315-355°	Float Test.
1	Creosote No. 1..55% Water-Gas Tar..45%	1.095	Trace	10.0	10.0	1.6	12.3	46.2	63.5	36.4	1.038	1.112	Over 160 Sec.
2	Creosote No. 1..65% Water-Gas Tar..35%	1.086	Trace	7.3	7.3	3.0	17.6	51.6	72.3	27.5	1.042	1.120	Residue less than 35%.
3	Creosote No. 2..60% Water-Gas Tar..15% Coal Tar.....25%	1.085	1.6	8.3	6.7	4.1	17.4	53.0	68.6	21.0	1.028	1.104	Residue less than 35%.
4	Creosote No. 2..50% Water-Gas Tar..35% Coal Tar.....15%	1.094	1.0	11.8	10.8	2.6	15.6	49.4	64.4	35.5	1.028	1.101	Not taken—thrown out by coke residue.
5	Creosote No. 3..65% Water-Gas Tar..35%	1.072	Trace	7.1	7.1	1.6	14.9	53.8	71.7	27.9	1.024	1.094	Not taken—residue less than 35%.
6	Creosote No. 3..55% Water-Gas Tar.22.5% Coal Tar.....22.5%	1.075	1.7	9.7	8.0	4.8	13.4	49.1	75.4	24.3	1.025	1.100	Not taken—residue less than 35%.
7	Com'l Creosote..65% Water-Gas Tar..35%	1.079	Trace	7.6	7.6	..	14.0	64.6	78.1	21.8	1.020	1.090	Not taken—residue less than 35%.
8	Com'l Creosote..65% Water-Gas Tar..35%	1.073	Trace	8.0	8.0	..	10.7	54.6	72.8	27.0	1.023	1.091	Not taken—residue less than 35%.
9	Com'l Creosote..50% Water-Gas Tar..25% Coal Tar.....25%	1.092	1.9	10.0	8.1	2.1	13.3	55.8	69.1	30.5	1.026	1.091	Not taken—residue less than 35%.

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All of the solutions have fractions whose specific gravities are well within the limits set by the specification.

Only one of these nine solutions would pass the tests if the specific gravities of the fractions were raised from 1.020 and 1.090 to 1.035 and 1.105, respectively, and the other tests (coke test and float test) remain the same. And none of them would pass if the specific gravities of the fractions were raised as above and the coke test were changed to read:

> "The bituminous coke residue (viz., the per cent. coke residue minus the per cent. of free carbon) shall not exceed 7%."

It is evident from the above that the test as proposed by the Joint Committee does not insure the purchaser of the pure coal-tar product. Neither does it guarantee that not more than 35% of tar shall be added. It is the opinion of the author that at the present time there are no tests which will infallibly separate a pure coal-tar product from a mixture of certain water-gas tars and certain coal-tar products, but the percentage of water-gas tars available for such mixtures can be very materially reduced by more rigid limits.

There seems to be two courses available, either of which, or both, may be followed. These are:

First, we should change the specification to read,—

a. The specific gravity at 38° C., referred to water at 15.5, of the fraction boiling between 235° and 315° shall not be less than 1.035.

b. The specific gravity at 38° C., referred to water at 15.5, of the fraction 315° to 355° shall not be less than 1.105.

c. The bituminous coke residue, that is, the per cent. of coke residue, minus the per cent. insoluble in benzol shall not exceed 7%.

Such a specification will include practically all pure coal-tar products. It will not, however, exclude completely water-gas tar products. Selected water-gas tars mixed with selected coal tars may still be used to the extent of 35% of water-gas tar, but the amount of water-gas tar available for such a mixture is considerably lessened by the change in the specification.

The second course would be to change the wording of the specification to read: "The oil shall contain at least 65% coal-tar creosote. The remaining 35% may be refined or filtered, retort or coke-oven tar or water-gas tar and shall have the following properties:

a. The specific gravity at 38° C., referred to water at 15.5, of the fraction 235° to 315° shall not be less than 1.020.

b. The specific gravity of 38° C., referred to water at 15.5, of the fraction 315° to 355° shall not be less than 1.090.

c. The bituminous coke residue, that is, the per cent. of coke residue minus the per cent insoluble in benzol shall not exceed 7%.

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This specification is the same as the one proposed, except that it openly permits the use of water-gas tar and changes the coke residue to bituminous coke residue to provide a means for limiting the water-gas tar to 35%.

The specification for distillate oil should have the specific gravity of the fractions raised as in the case of the paving oil, if a pure coal-tar distillate is desired. It must be frankly confessed, however, that even under these raised gravities oil may contain a considerable portion of water-gas tar distillates, if the tars from which they are produced are selected especially for this purpose.

MR. E. B. FULKS: Mr. President, that concludes the report of the Committee, with the exception of some recommendations for future work and the presentation as information of a great deal of very valuable matter to which I referred before. I believe the Committee has nothing further to present as a Committee. The President tells me it is necessary to move the acceptance of the report. I move the acceptance of the report, and that this matter be submitted as information, this matter that is referred to here on these various pages.

MR. R. V. LOOK: I second the motion.

THE PRESIDENT: All those in favor of accepting the remainder of the Committee's report as information—are there any remarks? If not, all those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. E. B. FULKS: That includes all the report of the Committee, and, Mr. President, Sub-Committee "D" has presented, as I said before, a great deal of valuable work about water-gas tar, and in connection with this Mr. Fulweiler desires to make some statement. In the meantime, will you excuse the Committee?

THE PRESIDENT: The Committee is excused.

DR. H. VON SCHRENK: Before the Committee is excused, I would like to make a motion. I remember last year during the meetings and during the winter the President tried to emphasize the desirability of engaging upon a policy of very constructive work. While this may be a little out of the ordinary, I believe that the work which this Committee has done deserves some special notice. It has done an amount of work I think most of us appreciate to a slight extent anyway, and before the Committee is excused I would like to move that a vote of appreciation and commendation be given on the part of the organization to the Committee for the work it has done.

MR. J. H. WATERMAN: I second the motion.

THE PRESIDENT: All those in favor of that motion will please stand. The motion is carried.

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MR. E. B. FULKS: Mr. President, the Committee feels highly gratified.

MR. A. E. LARKIN: Mr. President, before the Committee is excused, would it not be in order to at least mention the recommendation for future work. Mention of this has been made from the floor, and it is important that certain work along new lines be done by this Committee during the next year.

THE PRESIDENT: Mr. Larkin, I am going to give opportunity just after the Committee is dismissed for anything of that kind, but I think it is in perfect order to have those read if you care to read them, that is, the recommendations of this Committee for future work, if that is what you refer to?

MR. A. E. LARKIN: Yes.

THE PRESIDENT: I will ask the Chairman to read those.

MR. E. B. FULKS: Of course, the Committee did not necessarily mean that the future work should be confined to this. This is something that occurred to the Committee at the time, and any other instructions that the Association sees fit to give are perfectly proper, but the things that occurred to the Committee were the recommendations for future work given in the report.

MR. WM. A. FISHER: Will you entertain the motion that I previously made, at this time?

THE PRESIDENT: Yes.

MR. WM. A. FISHER: If so, I will present it.

THE PRESIDENT: All right.

MR. WM. A. FISHER: For reasons which I gave previously, I move the Committee be instructed to present next year additional distillate oil specifications similar to those of the American Railway Engineering Association, known as Grades 2 and 3 Specifications.

MR. R. V. LOOK: I second the motion.

THE PRESIDENT: Any remarks? All those in favor of this motion signify it by saying "aye"; contrary, "no." The motion is carried. The Committee is excused.

Now, gentlemen, I am holding you over the lunch hour a little bit, but I feel this is very important, and we have a pretty good audience. I would like to get through with the rest of this work before we dismiss. There are now one or two points with reference to oil that I am going to give the members an opportunity to present, and would like to have you act on them if you care to take any such action. However, I will ask these gentlemen to be as brief as possible, in view of the

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fact that the lunch time has arrived, and we have several matters yet to act upon before we will be able to adjourn.

MR. W. H. FULWEILER: Mr. Chairman and Gentlemen, according to the instructions of the Executive Committee, the Committee on Preservatives this year was unable to consider or present for adoption a specification on water-gas tar oil for paving blocks. Sub-Committee "D" has done a great deal of work on this subject and suggested a specification for water-gas-tar paving oil which was presented as information in the Committee's report.

We feel that this specification is worthy of further consideration, inasmuch as this year a general effort is being made to standardize certain specifications for preserving oils for wood-block paving among the various societies working to that end. This specification, with the specification for coal-tar oils presented by the Committee, have already been presented to the Society of Municipal Improvements and also to the American Society of Civil Engineers, and will probably be presented to other societies.

I therefore ask your consideration as to whether this would not be a very advisable time to have it adopted as a standard and included in the MANUAL, along with the other specifications, probably with the insertion of a paragraph, as is the practice, I believe, in the A. R. E. A. Manual, saying that water-gas-tar has been used for a number of years in treating wood blocks, and has apparently given excellent satisfaction. Therefore the Association would simply say that for people desiring to use this class of material we submit the specification for their guidance. I think such a paragraph should properly go in. The specification presented in the report of the Sub-Committee is a specification that has been in practical use for about eight years and covers a good many thousand square yards of wood-block paving. It has already been presented to several other societies, and is a specification that, in actual point of age and period of service, is probably older than the specifications presented here today. As I am not a Corporate member, I am going to ask Mr. Williams, who is, to make a motion concerning this proposition.

MR. J. C. WILLIAMS: Mr. President, along the lines of Mr. Fulweiler's remarks, I will simply say that in my own experience water-gas tar as a preservative for wood blocks answers all the requirements as given on page 2 of the report of the Committee on Specifications, for the Purchase and Preservation of Treatable Timber. I, therefore, have no hesitancy in offering this motion. I move that the specification for water-gas tar for paving blocks, as recommended by Sub-Committee "D," be adopted as a standard specification for water-gas tar and printed in the MANUAL for the guidance of those who desire to use this preservative.

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THE PRESIDENT: Is there a second to the motion?

MR. C. N. FORREST: I second the motion.

THE PRESIDENT: Any remarks?

MR. A. L. KUEHN: I think we have all observed how thoroughly the Committee has done its work, and as the Chairman explained, it has recommended all that it felt it was sure of. I think we should support the Committee in the recommendations as it made them.

DR. H. VON SCHRENK: I want to endorse that statement. In a progressive and successful organization of this sort success will come only when we depend upon those who have given most careful study and attention to the matter at hand, and follow it. Every technical organization in the country that has succeeded has done that. While the report of the Committee has given light and a new viewpoint, I certainly feel it is not the time to adopt that as standard until we have a great deal more and additional information, which the Committee assures us we will get next year. I believe that motion should not prevail.

THE PRESIDENT: Are you ready for the question?

MR. GEO. M. HUNT: I want to speak in favor of this motion. I think the time has come when this Association can go on record in favor of such a motion as Mr. Williams makes. We do not recommend the water-gas tar for any purpose at all. We simply say, if you want to use water-gas tar and want to know how to get a good water-gas tar, here is the way to do it. That is the same thing we did with the creosote-coal-tar solution. Why throw out water-gas tar and admit the solution? If we do one, we ought to do the other, in order to be fair to everyone concerned. I am very much in favor, therefore, of Mr. Williams' motion. It is absolutely fair to all in the wood-preserving industry and unfair to no one. It would be unfair to some people if the motion were killed.

THE PRESIDENT: Are you ready for the question?

THE MEMBERS: Question! Question!

THE PRESIDENT: All those in favor of the motion will please signify it by saying "aye"; contrary, "no." I guess we will have to call for a rising vote. There was a good deal of noise and it was impossible to decide the vote. All those in favor of the motion will please stand up. All those opposed, will please stand.

SECRETARY ANGIER: The vote is 29 to 9.

THE PRESIDENT: The motion is carried.

I believe there is another matter to be presented at this time, and I will now ask Mr. Teesdale to present it.

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MR. C. H. TEESDALE: This paragraph is in the Manual of the American Railway Engineering Association and was voted upon at the time that the specification for the coal-tar solution was adopted. I feel very strongly that it should be included in our MANUAL, with reference to the coal-tar-creosote solution for ties. Mr. President, I would like to move the adoption of this paragraph and its insertion in the proper place in the MANUAL. I will read it again, if you wish.

THE PRESIDENT: If you will, please. I think it would be a good idea.

MR. C. H. TEESDALE:

> This specification is submitted for the guidance of those desiring to use the coal tar addition to creosote for ties only, which practice is firmly established and widely followed. The creosote-coal-tar solution is not recommended as equal to creosote in preservative quality, and should be used for ties only when the available supply of creosote is inadequate.

THE PRESIDENT: Is there a second to this motion?

MR. W. F. GOLTRA: I second the motion.

THE PRESIDENT: Are there any remarks?

MR. S. R. CHURCH: I would ask that the Association give this motion careful consideration before taking action. The last statement in the proposed paragraph is a pretty strong one, and it is perhaps only fair to say that it is not in accordance with the belief of a good many treating-plant operators. I do not know whether this Association should commit itself definitely to that statement or not, especially in view of the specifications that have just been adopted by the Committee. In other words, the Association has already taken such action as will tend to prevent any misunderstanding on this subject. We have protected the purchasers to that extent, and I merely ask for due consideration before committing ourselves to a definite statement that the "solution" should not be used except when the supply of distillate oil is inadequate.

MR. A. E. LARKIN: Mr. President, it is imperative that this Association should make certain recommendations with reference to the preservatives to be used, qualifying their use for certain kinds of work and giving certain information that is required by everyone interested.

MR. A. L. KUEHN: Mr. Chairman, I stated before that this Committee had done good work. We are also satisfied that this Committee has done very thorough work. It has made a statement, a few men have gotten up here and made some statements as to grading of these specifications. I think it is due the Association to have presented to it by its Committee, complete and thorough information on

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which it can intelligently base such decision. I would like to amend that motion that this matter be referred to the Committee for thorough investigation.

MR. WALTER BUEHLER: I second the amendment.

THE PRESIDENT: Are there any remarks on the amendment to the motion? Are you ready for the amendement? All those in favor of the amendment that this paragraph be referred to the Committee for its study and consideration will please signify by saying "aye"; all those opposed, "no." The amendment is lost.

THE MEMBERS: Question! Question!

THE PRESIDENT: All those in favor of the motion that this paragraph precede the specification in this report, signify it by saying "aye"; all those opposed, "no." The motion is carried.

MR. A. E. LARKIN: Mr. President, I move that the Preservatives Committee be instructed to bring before us its recommendations setting forth the best oil in each class and specify them as No. 1 and No. 2, or "A" and "B," in order that the members of the Association can have some guidance in their work.

THE PRESIDENT: Is there a second to this motion? The motion is passed for want of a second. Are there any further matters?

MR. S. F. ACREE: Mr. Chairman, I would like to move an amendment to Section 5 on page 345, which reads:

> Begin a study of wood-preservatives other than zinc chloride and creosote,

and have added the words, "such as hardwood-tar creosote."

THE PRESIDENT: Mr. Acree, is that in any portion of the report that has already been passed upon?

MR. S. F. ACREE: Yes.

THE PRESIDENT: Well, I am afraid you are a little too late for that.

MR. S. F. ACREE: May I make this motion, that the Committee be instructed to begin next year a study of wood-preservatives other than zinc chloride and creosote, such as hardwood-tar creosote? I would like to have the motion put in that way. I would like to say briefly my reason for asking for the study of hardwood-tar creosote is the following: The Forest Products Laboratory has made a number of tests on the protection obtained from hardwood distillates, such as hardwood-tar creosote, and found it an excellent disinfectant, the high-boiling portions penetrating the wood nicely.

It is, furthermore, a fact that the hardwood distillation industry is thinking of going into the utilization of their tar, which at present,

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as you know, is practically a waste product, and to begin the distillation on a large scale, with the expectation of putting these materials before the public.

Since we have already had some study, and since a number of people are using creosote of this kind, and have informed me personally that they would be glad to try this material out thoroughly if given an opportunity, it seems that these materials are worthy of some consideration. Therefore, there ought to be some extensive study made of these oils, and I suggest this as one of the subjects, along with zinc chloride and creosote.

MR. W. F. GOLTRA: I second the motion.

THE PRESIDENT: Gentlemen, you have heard the motion. Are there any remarks? All those in favor of the motion say "aye"; contrary, "no." The motion is carried. Anything further?

MR. M. K. TRUMBULL: Place of next meeting.

THE PRESIDENT: I hope that this will only take a brief time. I regret very much that I felt it necessary to hold you over until this hour. I will now ask the Secretary to read communications with reference to a meeting place for 1918.

SECRETARY ANGIER: Just before I read these telegrams, it may interest you to know that our total registration up to this moment is 199; members 97 and guests 102. In addition to the invitations read yesterday, the following telegrams were received this morning: From the New Orleans Association of Commerce; the Mayor of New Orleans; from Mr. Manley, a member of this Association in New Orleans; and from the Chicago Association of Commerce (applause.) This is supplemented by a telegram from William Hale Thompson, Mayor of Chicago.

TELEGRAMS

FROM NEW ORLEANS ASSOCIATION OF COMMERCE
ERNEST LEE JAHNCKE, *President.*

We cordially invite the American Wood-Preservers' Association to hold its 1918 Convention in the city of New Orleans. Will do everything possible contribute to the success of convention if held here.

FROM MAYOR MARTIN BEHRMAN OF NEW ORLEANS

Speaking for myself personally and in my official capacity, I beg to extend a most cordial invitation to the American Wood-Preservers' Association to hold its next annual convention in this city. A cordial welcome awaits them, and all possible co-operation will be rendered in making a success of the meeting should it be held in New Orleans.

FROM MR. R. S. MANLEY, *Member of A. W.-P. A.*

Extend to the Association the combined invitation of the Creosoters in this vicinity. We promise blue skies, balmy days, mocking bird serenades, and a neat but not gaudy welcome to all.

FROM CHICAGO ASSOCIATION OF COMMERCE
GEORGE M. SPANGLER, JR., *Manager, Bureau of Conventions.*

Will you kindly present to the American Wood-Preservers' Association assembled in convention a cordial invitation on behalf of Chi-

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cago's commercial and civic interests to convene their 1918 meeting in Chicago? Every requirement for a successful convention is well met in Chicago, and we urge favorable consideration of Chicago's invitation.

FROM MAYOR WILLIAM HALE THOMPSON OF CHICAGO.

It will be a great pleasure for the city of Chicago to offer to the American Wood-Preservers' Association the hospitality of our city in 1918, and we urge your acceptance of Chicago's invitation.

THE PRESIDENT: Gentlemen, how shall we proceed to select this meeting place for next year? Bear in mind, of course, our lack of time.

MR. WALTER BUEHLER: Mr. President, it has been customary to have a written ballot, but due to the lack of time I suggest that we nominate certain cities and then take a standing vote by cities. I think this would hurry the matter.

THE PRESIDENT: Is there any objection to this plan that has been offered? If not, we will follow this plan. Nominations are now in order for the different cities.

MR. WALTER BUEHLER: I nominate Chicago as our next place of meeting.

MR. A. R. JOYCE: I second that.

MR. F. P. HAMILTON: Mr. President, I would like to nominate New Orleans.

THE PRESIDENT: Is there a second?

MR. C. H. TEESDALE: Mr. President, I move that the nominations be closed.

MR. A. R. JOYCE: I second the motion.

THE PRESIDENT: All those in favor of the motion that the nominations be closed will please signify it by saying "aye"; contrary, "no." The nominations are closed.

MR. J. H. WATERMAN: I move you we have a rising vote for Chicago (applause.)

THE PRESIDENT: I do not believe that is in order, because that has already been suggested, Mr. Waterman. All those that are in favor of Chicago will please rise to their feet.

MR. M. K. TRUMBULL: I think it ought to be clear as to whether corporate members only have a vote.

THE PRESIDENT: Gentlemen, our Constitution says that only corporate members are allowed to vote. Therefore the voting will be limited to corporate members only. All those in favor of Chicago will please stand up. (27 stood up.) All those in favor of New Or-

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leans will please stand up. (27 stood up.) The vote is a tie, gentlemen—27 to 27 (laughter.)

MR. J. H. WATERMAN: It is up to the President.

THE PRESIDENT: If it is left to me to decide I will have to vote in favor of Chicago (applause.)

MR. J. H. WATERMAN: It is all settled.

THE PRESIDENT: Gentlemen, if there are no announcements of any kind, we will now adjourn for lunch; but I would like to say that we have some very interesting papers to come before the convention, together with some Committee reports, this afternoon, and I will ask you to be back as nearly at 2 o'clock as it is possible for you to be. The convention is now adjourned.

An adjournment was then taken till 2 o'clock P. M.

WEDNESDAY AFTERNOON SESSION.

January 24.

The meeting was called to order at 2 o'clock P. M. by President Crawford.

THE PRESIDENT: Gentlemen, the first thing on the program this afternoon is, "The Bad and the Good in the Handling of Wood," by Mr. J. H. Waterman and Mr. George E. Rex. Mr. Waterman will say a few words just before the lights are turned out, and after he has made a few remarks he will begin with the pictures.

MR. J. H. WATERMAN: I want to say to you, gentlemen, first, that through the kindness of very many people I am able to give you the pictures which will be thrown on the screen this afternoon. I have one or two from Dr. von Schrenk and our good friend, Mr. Rex, has furnished some, and some from Mr. Angier, but there is nothing in any of the pictures that will give anybody away, especially those that are bad. None of you need be afraid—now just look at that proposition up there (referring to screen)! Is that not a rotten mess (laughter)? That belonged to John Brown. I am not going to do anything of the kind, and the only thing I am sorry for is that I did not get one or two pictures from our worthy President.

I passed Air Line Junction the other day, and I have a right to say this, Mr. President, if I want to. I saw the ties piled on that yard, and I wish we could throw them on the screen in a moving picture, and I think some of us would go home blushing. I am sure I would for one. Turn out the lights (laughter). Mr. President, you must not count this out of my time (laughter). I thought the Secretary had the pictures all ready to present.

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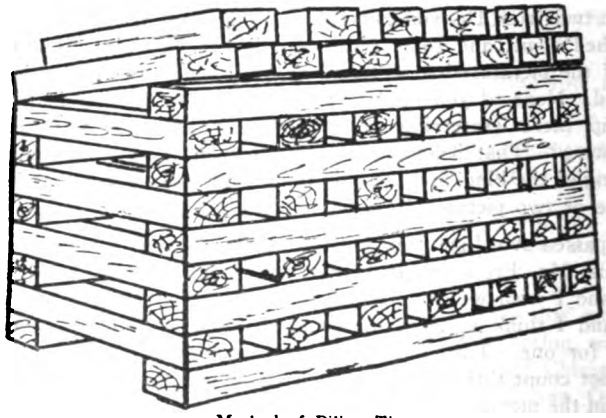
In order to treat ties you have to get them from some place, and here is a picture showing how they are piled on the right-of-way for inspection. Sometimes they lie around until they are all decayed or partially decayed before they are taken up.

Now, in some parts of this country they stand ties on end to receive them. There you see what happens if the ties stand around for

Ties Stood on End.

weeks or months, and the weather is wet and damp, and the ground is not favorable for piling ties for seasoning. I am told by men that went out to take those pictures that the ends next to the ground were in many cases decayed before they were taken up.



Method of Piling Ties.

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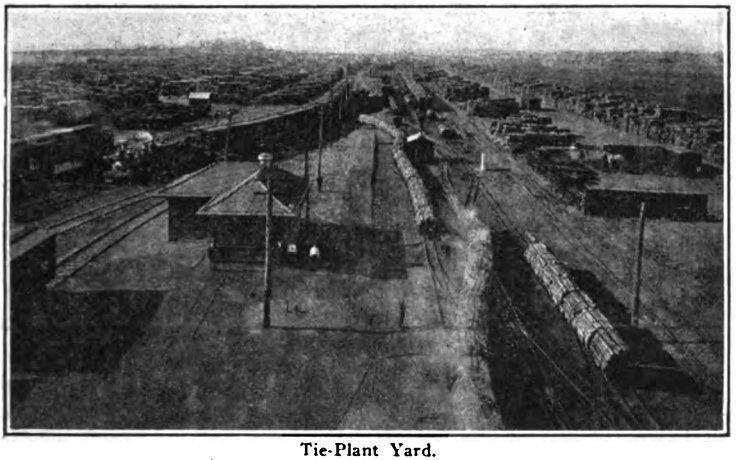
This picture is to show how ties ought to be piled on the right-of-way. They should be piled 7 and 2. Dr. von Schrenk is the man that gave that scheme to the Burlington Road.



Tie-Plant Yard.

Here is a view of a tie plant yard I am simply giving you this because there may be some men in the audience that have never seen a tie plant, and so you can get an idea how a plant looks. Then you will understand what we do.

Here is a picture of some cypress ties. Sometimes we talk about cypress being eternal wood, and that it does not need treating. However, you will notice that is sap cypress. I know a road in this country that gets the best kind of service out of cypress ties of this description, after treatment. You will notice everyone of them has practically the heart in them. Those that are familiar with wood know that they are cut from small timber.

Here is the front of a modern tie plant. You will note it is concrete. There are five retorts, apparently there, and room for another one. Here they are preparing to pull out a charge of ties from the retort.

Here is a loading platform. Most of you understand how ties are loaded at the platform, but I thought that I would give you these few pictures in order that those who were not familiar with tie plant operations might grasp the situation.

Here is an engine room. You will notice the recording gauges and all other gauges are all together and also the valves, so that the man does not necessarily have to run all around his retort, under them and over them, in order to open and close valves.

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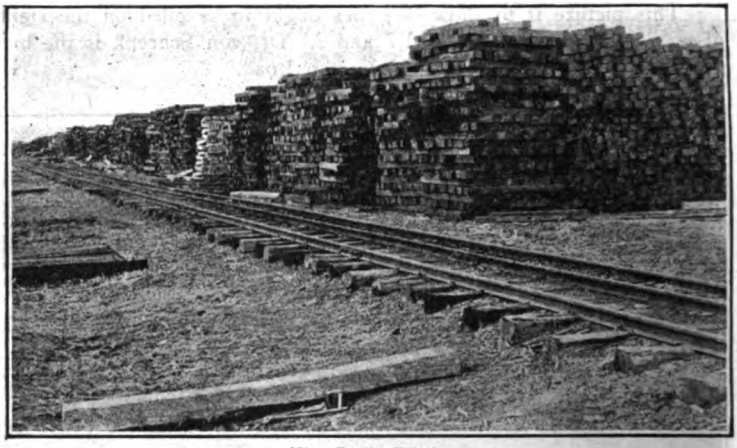

Ties Badly Piled.

Here is a bad pile. You will notice these ties are piled solid. Now, men, how can you season ties piled like that? It is simply a physical impossibility. Those ties are lying there, and the longer they lie the poorer they will get, and by and by when you treat them they will all be blistered, and if the fungi have not started on them, if you will cut the ends open you will find that they are not worth treating.

Loading Ties on Trams for Treatment.

Here is a yard where you see that they are loading trams of ties, properly piled. Those ties are seasoned, thoroughly seasoned, if you leave them long enough, and a tie, I think, should be on hand at least a

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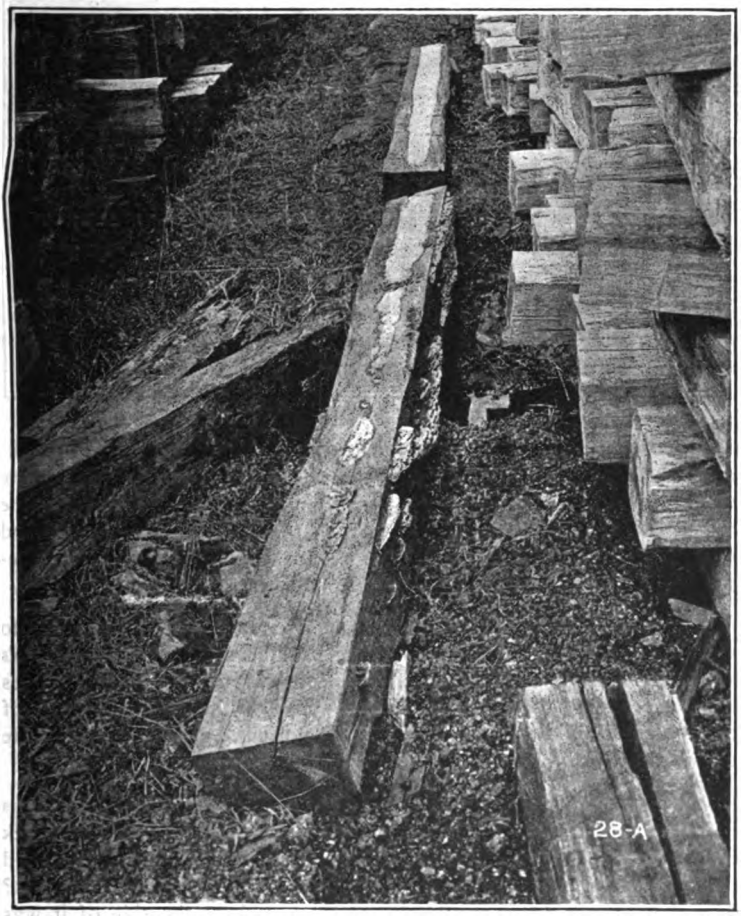
year before it is treated. Some people differ with me on that, but I would rather have it on hand a year than two months.

This is the way to pile piling to season. Piling piled up in that way and left there a year will treat fine. Those you will note are red-oak piling. You will see they are being handled by a locomotive crane. That is the only way and the proper way to handle piling.



Decaying Timber in a Badly Kept Yard.

Here is a picture. How does that look to you? Is not that fine? What would you think of a material yard or a tie plant yard like that? There is poison enough in one tie to poison a hundred thousand ties,

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if I am properly informed. Look at the grass and the weeds. You would think the insurance agents would get after them, if no one else did. Why, that would not make good firewood, let alone ties.

Decaying Untreated White Oak Ties.

There are some ties, gentlemen, white oak ties, after five years' service. Twenty-five per cent. of the ties in the mile of track where those were taken out were taken out after 5 years' service. I estimate that 25% will be taken out next year, that is 6 years; 25% at the end of 7 years, and 25% at the end of 8 years. Now, some of you mathematicians, tell us what the average life will be.

I say it is a crime to waste timber that way. What ought we to do? We ought to treat all our white oak the same as we do others (applause). It is fair and just for me to say to you that these ties came from south of the Ohio River—most of them, probably all of them—and the white oak in the South is not quite as firm as the white oak in the North.

What do you think of that, gentlemen? There is a fir tie that has literally been destroyed. I know all about it. That tie was in track 6 years. The track right along side of it, that was laid with treated fir ties, lasted 16 years. Why one 6 years and the other 16 years? This was light rail and no tie-plates. The track at the side of it was tie-plated and heavy rail. I want to show you two or three more pictures on that, and then I want to make some remarks. There are some more. Look at them—literally, mechanically worn out. Why? Simply because they were not mechanically protected. Here is another

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bunch, and I will say here without fear of contradiction that not a trunk line in these United States that runs heavy power but that I can go on its line and find in its side tracks thousands of ties destroyed like that. What does that mean? That means if the treating engineers of this country have reached the point where they can treat timber that will outlast the mechanical life of a tie, it is up to the engineers of this country to get busy and provide some way so as to save the ties mechanically.

I hope to live long enough to see the day when at least 99% of all the ties used in this country are treated, and if I was a member of the Commission of this country—of the Railroad Commission—I would insist that ties be treated, because we destroy our forests, we waste our time and we waste our money, and when the gentleman that addressed the convention at our last meeting said you could save $100,000,000 a year if your ties and timber were treated, he was about 50% too low (applause).

MR. GEO. E. REX: Gentlemen, the Committee very kindly gave me an invitation to show some slides in connection with Mr. Waterman's talk, but at the time that the invitation was issued I did not expect it would be possible for me to be here. I therefore had to refuse, and it was only at the last moment I found it possible to come. I had no chance to prepare any talk or assemble my slides in the right shape, and have only brought a few along in my pocket to show you one or two things for a reason that just came to my notice.

I happen to be a member of a committee of the American Railway Engineering Association, and we had some new members. They were not treating men, but they were prominent engineers—Engineers of Maintenance of Way—the men that we want to reach, the men we want to be able to convince what we are able to do with timber preservation. One of those gentlemen was asking for information, and, in telling his experience, said this: "When we rebuilt a piece of line a number of years back, we decided to use treated ties."

Up to this time the road never used treated ties. They bought and put in, out of face, red-oak zinc-treated ties. He happened to be on the piece of track during construction, maintained the track afterwards, and kept a perfect record. He got eleven full years' life from those Burnettized red-oak ties, with which he was satisfied.

Four years later, in building some other tracks, these ties looked so good, they decided to do the same thing. They again bought from the same plant, under the same specifications, and the same conditions, another bunch of ties—red oak, Burnettized. He was in a position to see when they were put in, and knew absolutely from a perfect record of the track.

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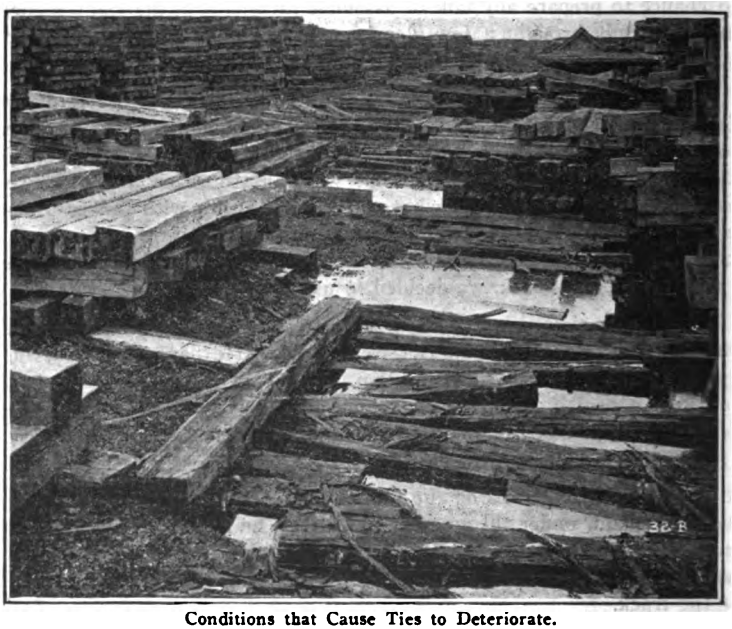
He got 4 years' life out of those ties, and the thing he asked us, and he wanted to know was the why of this failure. To him there was absolutely no reason; he had no explanation; it was Greek to him. He did not know why, in buying on the same basis, and buying the same ties, and getting such excellent results with one lot, and buying the second lot of ties under exactly the same conditions, and getting inferior results.

That road practically ceased the purchase of treated ties, and that road is almost 6,000 miles long.

The other gentleman purchased, just a few years back, several hundred thousand loblolly creosoted ties. He went to the trouble of putting in screw spikes, and was supposed to get excellent results; had every reason to expect excellent results. In four years' time, he told us, he could take those spikes and pull them out with his hands. The statement that he made to us was that loblolly ties were not worth using in track construction. I just want to show you the slide, and I wish I might have brought along the two gentlemen, so they could have told their experience. I just want to show you these slides, not that they are anything new, but to help you realize that those are the gentlemen we have to convince, and we have to preach, (as Mr. Water-



Conditions that Cause Ties to Deteriorate.

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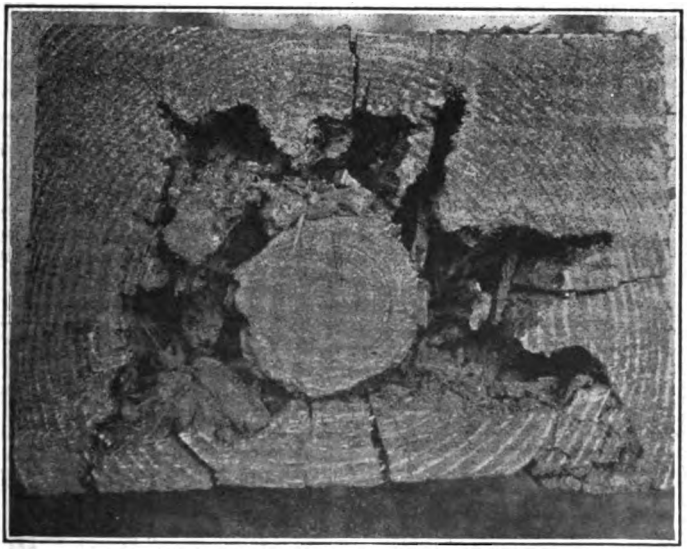
man says), in season and out of season to convince such gentlemen as that, that their methods were wrong, and not the treatment. There is the reason for the 4-year ties.

The next four or five pictures—there is nothing new about these, but this is the condition under which those ties were taken care of, that caused the man to get 4 years' life out of his ties, where he could just as well have had 15.

The only reason he did not get more than 11 years out of the other lot of ties was because they went through the vicissitudes of a construction track, and had no mechanical protection, and were very badly abused.

These are pictures similar to what Mr. Waterman showed, but they are actual conditions. They are seen in numbers of tie yards. That is water, fungus, every condition possible, absolutely every condition conducive to decay in and around seasoning material.



Result of Treating a Rotten Tie.

There is an example of a creosoted tie. It was in the track 14 months. This tie was passed by two first-class inspectors, men thoroughly familiar with pines and thoroughly familiar with treatment, and there was absolutely no sign on the outside of this tie to show that it was not first-class. It was treated and put into the track, and in 14 months came out in the condition you saw in the picture before; that is, it broke through under the rail. There was absolutely no

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sign but what it was all right, until it broke through under the rail and sawing a cross-section this is the condition we find. Now, this tie was treated with creosote, and, as I said, there was no sign, nothing that would tell a man what the interior condition of that tie was, and yet in 14 months this is its condition, and this is the reason why the second man got 4 years' life out of loblolly ties, and is convinced in his own mind that loblolly ties are a failure.

Now this is a picture of a loblolly pine tie that was cut in July this year. It is not a single example, as I will tell you later. We have had probably as good a seasoning year this year in the South as we have ever had, running along for months with no signs of decay, running all the ties through the boring and adzing machines, where the ends are cut off and there would not be 10 or 15 ties a day that would show any signs of decay. The first of November, without any apparent reason at all, a visual inspection of the ties would show the same condition as ties treated the month before, but we commenced to get ties in this condition, and we have been culling in a day's run from 250 to 1,000 ties, finding them in this condition, absolutely no sign on the outside of these ties, no fungus, nothing that would tell a man that the tie was decayed, on the outside, and yet the cut-off saws reveal this condition. This is simply one of 250 that we took. I just happened to be at the plant and counted this day's run, and there were 250 ties of

TIES IN TRACK ON A. T. & S. F. RAILWAY.

Years	Total miles	Total Ties in in Track	Total Inserted for Renewals	Percentage of Total Ties Inserted to Total Ties in Track	Ties Insert- per mile
1896	5,405	16,401,792	1,867,441	11.39	346
1897	5,339	16,181,440	1,611,509	9.96	302
1898	5,356	16,236,000	1,254,936	7.73	234
1899	6,171	18,585,952	1,290,282	6.94	209
1900	5,856	17,637,312	1,187,958	6.74	203
1901	5,900	17,759,456	1,075,041	6.05	182
1902	5,981	18,003,040	1,369,140	7.61	229
1903	6,135	18,524,352	1,470,286	7.94	240
1904	6,379	19,266,720	1,751,095	9.09	275
1905	6,989	21,164,932	1,869,233	8.83	267
1906	7,467	22,693,360	1,159,219	5.11	155
1907	7,427	22,522,324	2,067,651	9.18	278
1908	7,712	23,355,824	2,304,347	9.87	299
1909	8,041	24,391,488	2,355,540	9.66	293
1910	8,563	27,294,336	2,352,184	8.62	275
1911	8,872	28,270,420	2,335,796	8.26	263
1912	9,043	28,810,592	2,074,492	7.20	229
1913	9,168	29,208,992	1,818,205	6.22	198
1914	9,568	30,481,120	1,714,102	5.62	179
1915	9,552	30,422,416	1,879,897	6.18	197

similar condition to this that were thrown out in that one day's run. This is another. Now, men, there is absolutely no way for a man to tell this condition, except as revealed by a fresh cut, and until we get

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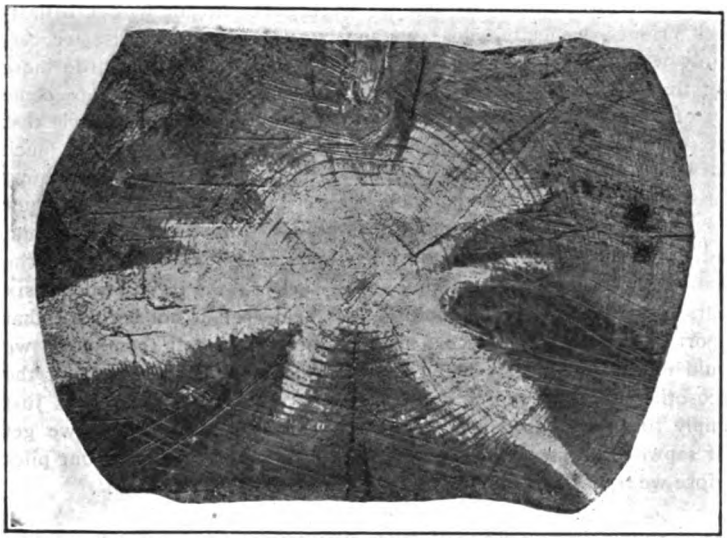
to a point where we can know what we are treating, we can expect to be told, like the gentleman told us, that the loblolly ties were no good. This is the answer that I would have to make to the man who said the loblolly ties were no good.

This is a Santa Fe tie renewal statement for a period of 20 years. You have all seen this table in the paper; so it is nothing new, but when I tell you that 50% of the Santa Fe ties are loblolly, and we are getting, as you see in the last column (1915), an average of 197 ties renewed per mile of track, it means more than 15 years. Do you suppose that that gentleman would have any trouble convincing me that loblolly ties were no good? You cannot put that kind of a thing across when you have an absolute record of the renewals on a large mileage of track as we have and as numerous other railroads here have.



Effect of Improper Barking on Treatment of Ties.

This is simply a picture showing the results of improper barking of ties, and what we can expect in the way of treatment if we do not take proper care to clean ties off—lack of penetration and the sapwood left unprotected. The ties are going to decay.

This is simply a picture of the improper use of creosoted material. The chief engineer has gone to the trouble of making a built-up whistling post, in order to get a creosoted base, which will not decay, and yet the man has taken a creosoted stick and sawed it in two, and left the exposed heartwood turned up to the sun and rain, an ideal

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condition for all the decay that is going. It would have been a great deal better if he had thrown his money away than to have put it into treatment for that stick, if he was going to use it in this manner. It is a small structure, but it simply illustrates what is being done every day in sawing creosoted material after treatment.

This is another example of piles improperly treated. These piles were treated under our specifications, green, with a 10-lb. treatment. I happened to be out inspecting track in 1907 when the man who was driving this pile into a ballast-deck bridge, a bridge in which, unless we can get 30 years' life, we are making a mistake, and we can get 30 years' life if we will do the work right, it just so happened that I came along and immediately had him saw off this sample, which I have in my office, and I wrote a report to the effect that if this was the kind of creosoted material that we were going to put in our ballast-deck bridges, we better close up our treating plants, because we certainly would never get anything like a life expected, very little more life than the untreated material. This material commenced to come out of these ballast-deck bridges in 1910 and 1912, and our people that are responsible for the spending of our money began to get very much alarmed, and several of our men that have the influence in shaping our policy were ready to throw up their hands and say, "We will quit the creosote business for piling; absolutely quit the business," and had it not been for this particular sample that I showed you in the picture before—and this sample goes back to the same bridge six years later, and this is the condition of them—had it not been for that report, which went on record 6 years before, to tell them what we could expect out of this material, we would very likely have quit the creosoting of piles, and thus made a very serious mistake. It is just simply to show that unless we do the work carefully, unless we get our sapwood all penetrated, unless we get the moisture out of our piles before we treat them, we are making a mistake.

It should be the duty of every treating man to absolutely insist not only that his treatment be done in the right manner, but he should be furnished plenty of oil to see that he gets every bit of his sapwood penetrated, and if he does not, this will be the result. We took out over 6,000 sticks in 6 years of this kind of material out of ballast-deck bridges, and yet to anybody that has followed the creosoting business, as we do, those of us that are interested in it and are following it day by day, there is absolutely no question in any man's mind but that he can get 30 years' life out of his piling. He can figure on 30 years' life if he will get proper penetration with the proper kind of preservative.

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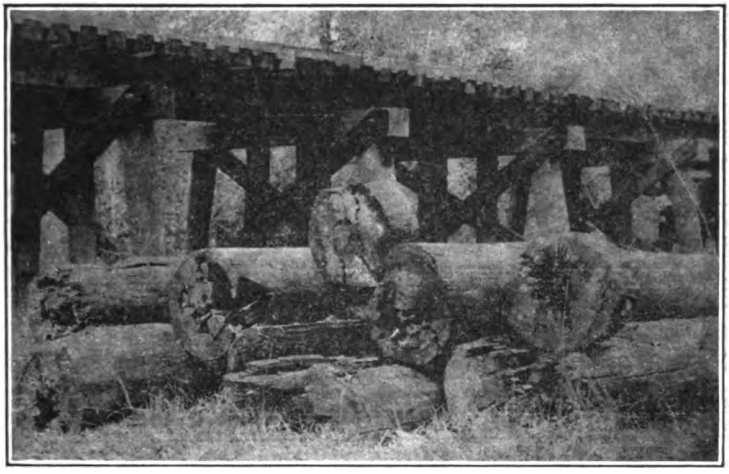
This is simply a lot of these creosoted piles removed after 6 years' life. This is the condition they are in. That is all due to lack of penetration, and the man that treated this material was not responsible, mind you, or anywhere near entirely responsible. He was given a specification that allowed him to put in 10 pounds of oil in such piles as that (three-fourths sapwood). We all know that 10 pounds under



Result of Insufficient Treatment of Piles.

that condition will not penetrate the sapwood. He was bidding in competitive business; he had to take the contract, and if he had not treated it, somebody else would have treated it. The road is responsible. The road that will allow that kind of a thing to go is responsible for that condition.

This is a picture on the improper use of creosoted material—a picture of a drain box. This is the top of a creosoted drain box that has been in the ground ten years, and it is typical of what you may expect if you saw creosoted material and put it into the ground after treatment. Every block in the top of that box that is decayed is a sawed block. Every block that was not sawed is in absolutely perfect condition. I have two or three samples here in my hand that I am going to show you, after I show the other pictures, to show the end penetration, to show that the seal has not been broken and that the block is in perfect condition, is good for an indefinite life, and this is the condition and yet, some say creosoted material is no good, that we

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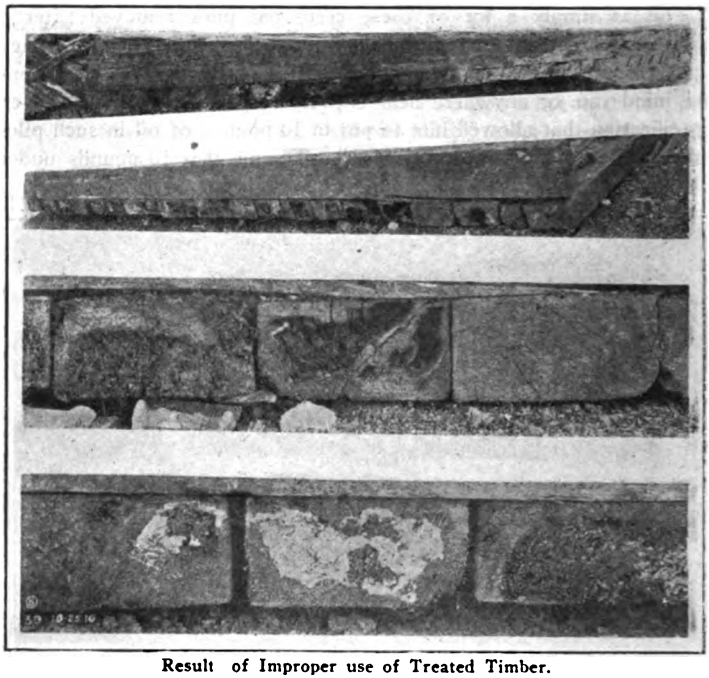

Result of Improper use of Treated Timber.

will cut out the creosoted material in this structure and that, because it is no good. It is no good, because the man has abused it, and not because the treatment is not right.

Here is an example of a drain box which was reported as a failure, a creosoted box, in 1914. The chief engineer received a form from the division engineer for authority to put in a new drain box at this particular location. The old box, the records showed, had only been in 11 years. He asked me at once why we were taking out a creosoted drain box in 11 years, and I just happened to be able to go personally to see that particular box. And when I got on the ground I found that the box had originally been put in on the main line 11 years before, was untreated white oak box, and had given, as you will all admit, quite unusual life in that condition. Three years before this they had extended the siding, the passing track, along past this box and put in what was supposed to be a creosoted box under the passing track. I went out to the end of this box and found these creosoted planks and the end of the box beyond the passing track. I was pleased to see the condition of the box. At this time I had not known how long this creosoted box had been put in at all, but in getting down and looking

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through the box I was surprised and flabbergasted to see hanging down, in the center of the box, about 8 ft. from the end, great quantities of fungi. I could not understand it. I could not realize it. I could not feel that it was possible that this fungus could be growing in this box. The end planks were excellent, and the side plank all along you could see was in excellent shape, and yet, back there, only 8 ft. back from the end, great quantities of fungi were growing. I immediately got the section gang to excavate around that box to find out what was the matter. When I got down to the box, this is the condition I found, just exactly, and it was so important that I right then took the box and sawed this section out, and rebuilt the box in the office with three pieces of boards, just as I found it there in the ground. What the man did was this: He sawed every creosoted piece that went into that box after it was treated. He did not have quite enough boards to come together to complete this top, so he went out and picked up a 2-in. plank and filled in this space, as you see. One was not thick enough, so he put a second one on, and these two untreated pieces in three years' time were in the condition as you see, and not only that, but they had infected the sawed ends of the creosoted plank.

Now, men, what can we expect if we are going to let our material be mutilated in this manner? That box, and just such examples as that, gives the man that does not know the creosoting game a feeling that there is some bunk; there is something in the treating game that is bunk. It is our duty—I feel it is the duty of every one of us to follow up these things to the end in order to stop this kind of work.

This is simply a picture of our modern boring and adzing plants, in which we put through all our ties. The ties are put on to a conveyor on the other side and passed through these cut-off saws; the second machine adzes them; the third machine bores them, and the fourth stamps these ties, as you saw, on the ends. It might be of interest to you to say that we have five of these plants in operation, and one plant we are operating night and day, turning out approximately 11,000 ties on four shifts. Every tie going through our big plant there is put through these machines.

We have a method of preventing the destruction of our ties by mechanical wear, as this picture shows. Mr. Waterman showed you some excellent examples of what mechanical wear is doing, and we are at a point now where anybody that has followed the treating business is absolutely convinced and can convince anybody that will give him time to talk to him that we have solved the treating problem, and a man can be absolutely assured, if he will do the work right and pay the money for it, and the work is done honestly, he can be absolutely assured of getting more physical life out of the ties than we can get mechanically. I do not agree with Mr. Waterman. It is not up

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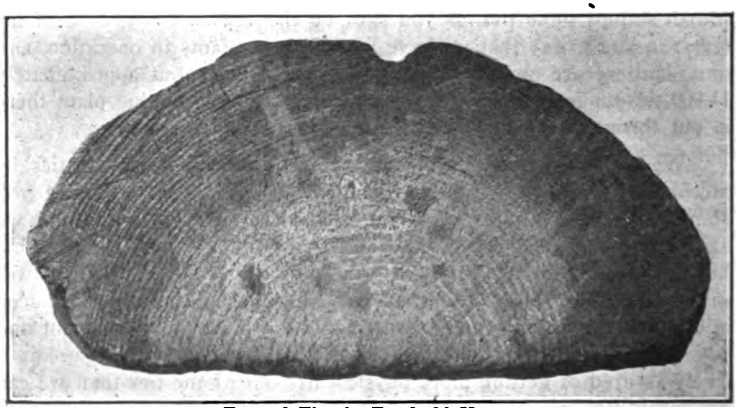
to the mechanical engineer to get mechanical protection but it is up to us to force mechanical protection, and we can only do it by showing and convincing these people that our first-class creosoted material and zinc-treated material is being removed on account of the mechanical wear, and not on account of decay. We are finding that large numbers of our ties are now coming out on account of mechanical destruction in and around the spike, where the spike has destroyed the fiber until it will no longer hold the spike where the rail is cut, and they are mechanically destroyed.

This is simply one of the methods we have taken to get more mechanical life out of our ties with the wood dowel. We are now putting in a couple hundred thousand dowels in some of our softer woods, like the redwood and loblolly pine. It takes money, but if we could do this we could avoid mechanical destruction of these soft-woods. There is absolutely no reason why we should not be getting twenty-five years, just as well as twelve or fifteen years if we would do this in our softer woods. The redwood ties, for instance, as you know, we do not treat, but we are using redwood ties largely on our coast lines. Those ties are just about half as strong as the longleaf or the Douglas fir ties. Those ties (the most of them) will not decay. There is no reason why we cannot get fifteen or sixteen years out of those ties if we can protect them from mechanical wear, and this is the method we have taken to start to protect our redwood and our Douglas fir and our loblolly pine ties from mechanical wear. Here is a sample of a pile treated in 1875 and removed in 1912, when the causeway was put across Galveston Bay. The only reason I am showing this picture, which is the air section of a pile in that climate, which you all know is as severe as any climate in the country, is simply to show you if the material is well creosoted there is no such thing as decay.



Treated Tie in Track 26 Years.

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The next is simply another picture of the same kind, in which the tie has been in the track 26 years. This is a Baltic fir tie. It is the old French tie, as all of you know. It has been in the track 26 years—ten years without dowels and 16 years after having been dowelled—before the tie was removed for inspection only. It is simply another example of what you can expect if you will properly treat them —26 years' life. There is no reason why that tie will not give 10 years' more service. The interesting feature of this tie particularly is the small amount of penetration that is necessary on the heartside of these ties. For that section that treated area is not broken, so that the moisture and dampness and spores and everything has to pass through the treated area. As long as you can maintain that area your heartwood will not decay, if you have all your sapwood penetrated and maintain a seal of creosoted material. This tie is not creosoted at the bottom more than a ¼ in., and yet it is perfectly sound. It might be of interest to say that the later developments in the Douglas fir tie, which we all know is rather hard to treat, have demonstrated that we can control the penetration in Douglas fir by the new mechanical method. With that and boring and adzing those ties, there is absolutely no reason in the world why our Douglas fir tie is not going to come in and give us just as good ties as our longleaf creosoted ties.

These, gentlemen, are all the pictures I have here. If you will turn on the light a moment, I just want to show you what I have here. Here is a sample of that piece of drain box. There is the condition of the ends of every plank that was sawed. Here is the condition of everyone, or the original ends, of the plank. Now, men, there is not a man in the house that can afford to see and allow a single stick of creosoted material sawed after treatment and not make a kick about it. If we are going to get results out of our treating, we must see that it is properly handled mechanically. This is important, because you are all going to have trouble with failures if you do not follow this stuff up (applause).

THE PRESIDENT: Gentlemen, I know you are fond of moving pictures. We prepared some for this afternoon, but the machine is not working out very well. We made an application for a license the other day, and we turned it over to a man whom we thought would take care of it and have the license on hand. He evidently turned the application over to another man and the license was taken out, but has gone astray. It is not here; and they refuse to turn on the current until the license is here. It will be here in a very short time, but we have no assurance of just how long it will take. Our time is growing short, and I think we would better go ahead with another part of our program until we have this license here and can go ahead with the moving pictures.

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MR. J. H. WATERMAN: Mr. President, I would move you that we go ahead, if you need a motion, and when the license comes we can turn out the lights. We can give ten or twelve minutes to the moving pictures almost any time, if that is satisfactory to everybody. I know we are disappointed.

THE PRESIDENT: Is Mr. Teesdale in the room? We have two committee reports to be presented this afternoon, and if Mr. Teesdale is not ready, we have a short paper on our program, "The Grouping of Ties for Treatment," by Mr. C. P. Winslow, which I think we will have now. Mr. Winslow is not here, but Mr. Hunt will give us this paper.

MR. GEO. M. HUNT: Mr. Chairman, the paper is very short, and I think I will read it all in order to get it before the convention.

THE GROUPING OF TIES FOR TREATMENT.

By Carlile P. Winslow.

Assistant Director, Forest Products Laboratory, Madison, Wis.

At the last annual meeting of the Association the writer in conjunction with Mr. Newlin, presented a discussion of Mr. Van Meter's paper on "Woods Suitable for Cross-Ties." This paper and discussion presented at some length a basis of classification of woods used for cross-ties according to their mechanical properties, and included a tabulated classification of a wide number of species. Many of these woods, due to their susceptibility to decay, are either not well suited for ties without a preservative treatment, or require a preservative treatment in order to give results of greatest economy. Some data and discussion to serve as a basis of classification of these woods according to their relative ease of treatment should, therefore, round out the situation.

The subject is one which has received considerable attention and discussion at past meetings of the Association. In 1910 Mr. Angier contributed an interesting presentation of the matter, and in 1911 attention was again called to it by Mr. Goltra's exhaustive paper and the resulting discussion. While there has been little further direct discussion of the subject at subsequent meetings, it has from time to time been touched upon more or less directly in connection with other problems of the wood-preserving industry.

In its broader aspects, the proper grouping of ties for treatment is dependent upon a variety of variables. Aside from the inherent variations of individual species, we must contend with variations in moisture content, variations in the proportion of heartwood and sap-

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wood, variations in the form of the ties, in the character of treatment desired, and in the character or kind of preservative used. According to the combination of such variables that may exist at a given plant at a given period or season, so will be determined the grouping best suited for its needs. But the underlying and governing factors are the inherent differences in susceptibility to treatment of the individual species.

It was to secure a comparison of this nature that a series of tests were conducted at the Forest Products Laboratory under the immediate direction of Mr. Teesdale, who has given much assistance in the preparation of this paper. He has published a detailed account of the experiments with coniferous woods in Bulletin 101 of the Department of Agriculture. Similar tests have since been carried on with hardwoods, and a brief description of the methods used will apply to the entire series.

Air-dry specimens were used throughout. So far as practicable both heartwood and sapwood were included in the tests. Coal-tar creosote was uniformly used, and two classes of treatments were included. One involved an application of the preservative for a given time, through a pipe applied to a hole bored at the center of the specimen, with the subsequent exact measuring of the extent of the penetration. The other method involved impregnation in a small cylinder for a specified time, with a subsequent determination of absorption and penetration. Throughout the tests, the temperature of preservative, intensity of pressure, time of application, etc., were kept constant, and in fact, all possible precautions were taken to eliminate all variables save one, namely, the species.

The results are shown in Fig. 1 and 2 where the data for the conifers and hardwoods are separately presented. The results with both heartwood and sapwood are included in so far as both types of specimens were used. It is of special interest to note the results with chestnut oak. This species has always been classed both botanically and commercially as a white oak, but was found to treat with about the same susceptibility as red oak. In connection with the Douglas fir, it is also to be noted that it was of the mountain variety; other tests with this species from both the mountain and coast regions have shown the former much more resistant to impregnation with creosote than the latter.

The extent to which the results as presented above are applicable to an actual grouping of ties for treatment is the next question of importance. It should first be kept clearly in mind that any general grouping based entirely on the species is entirely impractical. The striking difference in the susceptibility to treatment of the heartwood

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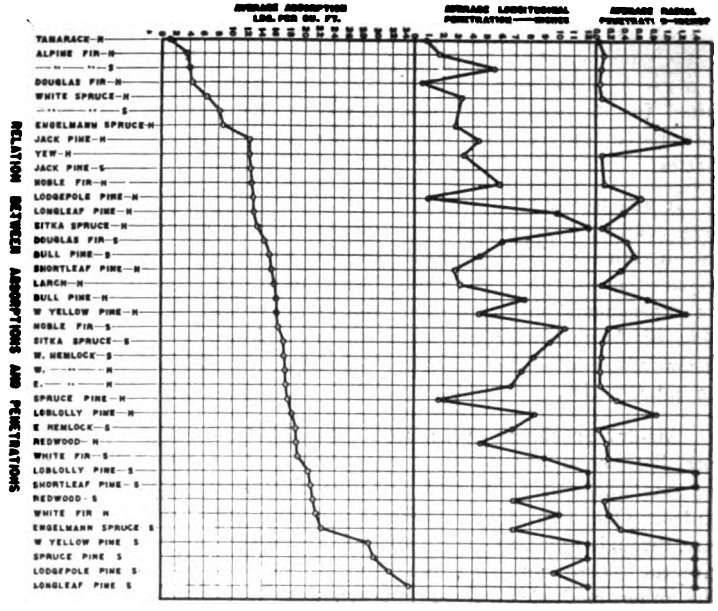

Fig. 1.—Conifers.

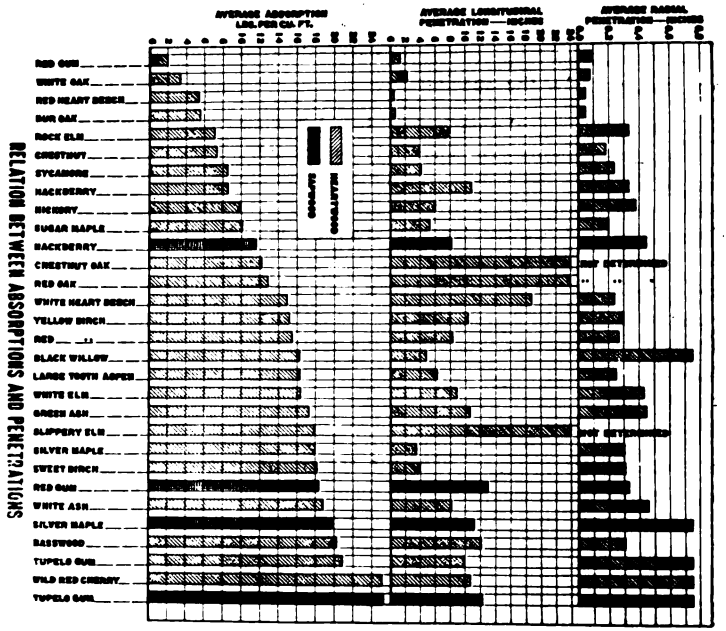

Fig. 2.—Hardwoods.

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and sapwood of nearly all species is so generally recognized that it scarcely needs comment; the innumerable combinations of relative proportions of heart and sap which may exist in individual ties is equally well-known. As previously indicated, therefore, the problem is of a dual nature: first, a consideration of the relative ease of treatment of the sapwood and heartwood of different species, and secondly, a classification according to the form of ties it may be desired to group for treatment at a given time and place.

To further illustrate the point, Fig. 3 is presented. It shows a number of representative types of ties. Consider for a moment ties "A" and "(A)" as there illustrated. Even if of the same species, it cannot be doubted that in the majority of cases two such ties would treat with greater dissimilarity than two ties similar to either "A" or "(A)" but of different species. With ties such as "B" and "E," the complications would be even greater, since the proportion of heart and sap in each case might vary over a wide range.

In order to present even the most general grouping of ties for treatment, some classification must, therefore, be adopted. Innumerable classifications might, of course, be drafted, but the following, which is the same as that recommended last year for structural timber by your Committee on Specifications for the Purchase and Preservation of Treatable Timber, will serve the purpose:

Class 1. Ties showing no heart on any face.
" 2. Ties showing no sap on any face.
" 3. Heart face ties with not less than 80% heartwood.
" 4. Heart face ties with not over 20% heartwood.
" 5. Other ties not falling in any of the foregoing classes.

To accompany the foregoing classification, the following grouping, based primarily on the previously discussed data, is presented as generally indicative of the relative ease of treatment of the different species used for ties. The species in each group are listed alphabetically, and the groups are listed in order of ease of treatment:

Hardwoods.

Group 1.—Sapwood.

All species listed below are reasonably susceptible to treatment.

Group 2.—Heartwood.

Ash, white.
Ash, green.
Basswood.
Beech (white heart).
Birch.

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Group 2.—Heartwood.—(Continued.)

Cherry, wild.
Elm, slippery.
Elm, white.
Gum, tupelo.
Oak, red.
Oak, chestnut.

Group 3.—Heartwood.

Aspen, largetooth.
Elm, rock.
Hickory, mockernut.
Maple, silver.
Maple, sugar.
Sycamore.

Group 4.—Heartwood.

Beech, red heart.
Chestnut.
Oak, white.
Oak, burr.
Gum, red.

Softwoods.

Group 1.—Sapwood.

All species listed below easy to impregnate with the exception of the following:

Alpine fir, white fir, white spruce, hemlock (eastern and western). These are considered further in Group 4 below:

Group 2.—Heartwood.

Pine, jack.
Pine, loblolly.
Pine, longleaf.
Pine, Norway.
Pine, shortleaf.
Pine, spruce.
Pine, western yellow.

Group 3.—Heartwood.[1]

Pine, lodgepole.
Fir, Douglas (coast).
Spruce, Englemann.

Group 4.—Heartwood.

Cedar.
Cypress.
*Fir, Alpine.
Fir, Douglas (mountain).
*Fir, white.

[1]Some question as to whether the lodgepole pine and Englemann spruce should not be included in Group 2 and the Douglas fir in Group 4.

*Includes sapwood.

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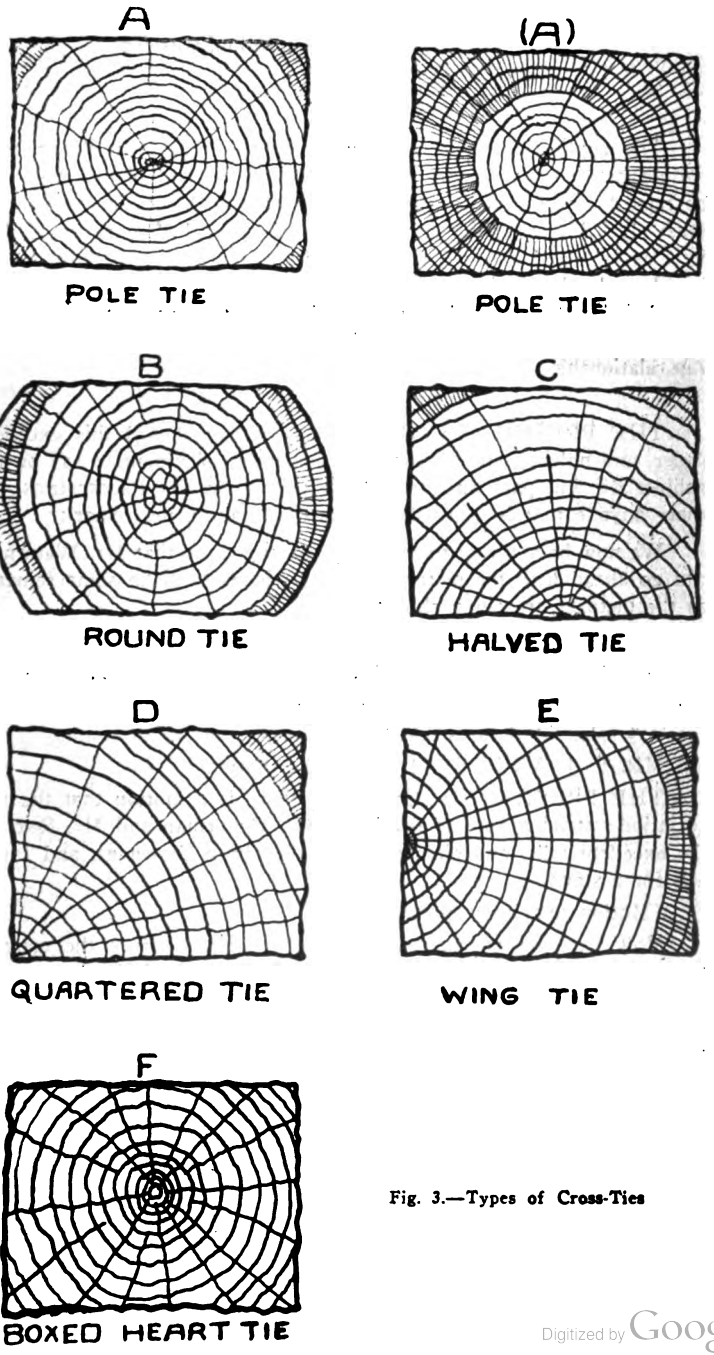

Fig. 3.—Types of Cross-Ties

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Group 4.—Heartwood.—(Continued.)

**Hemlock, eastern and western.
Larch, western.
Tamarack.
**Spruce, white.

The application of this grouping to the suggested classification should prove of assistance to operators of treating plants, especially as regards species which they may not have had occasion to use extensively. The grouping would be especially applicable to ties falling in Classes 1 and 2, and reasonably, although less so, to those falling in Class 3. Predictions cannot be made for these falling in Classes 4 and 5, but from the data presented, some idea as to their capacity for treatment could be determined by a consideration of the heart and sap relationship.

THE PRESIDENT: Gentlemen, you have heard this excellent paper, and unless some of you have something pertinent to say on the subject we will pass on and have it printed in the PROCEEDINGS. Is there anyone that is especially anxious to make some remark?

We now have the picture machine arranged, so that Mr. Waterman can go ahead with the pictures, and he wishes to make some remarks as the pictures are being shown.

(The moving pictures were then shown.)

MR. NELSON C. BROWN: I move that a vote of thanks be extended from the Association to Mr. Waterman and Mr. Rex for the very splendid pictures that we have seen.

MR. F. J. ANGIER: I second the motion.

THE PRESIDENT: Gentlemen, there is a motion that the Association extend a vote of thanks to Mr. Waterman and Mr. Rex for the excellent talks and pictures which they have shown us, and I will ask for a standing vote.

(Motion unanimously carried.)

Now we have an interesting report to come before the convention, the report of the Committee on the Purchase and Preservation of Treatable Timber. The members of the Committee are: Mr. A. R. Joyce, Chairman; Mr. J. B. Card, Mr. O. P. M. Goss, Mr. F. R. Martin, Mr. George E. Rex, Mr. Lowry Smith, Mr. E. A. Sterling and Mr. C. P. Winslow. I would like these gentlemen to kindly take their places on the platform.

MR. A. R. JOYCE: Mr. President and Gentlemen: You all have the report of this Committee. It is hardly necessary to read it now.

**No real distinction between heart and sap.

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You will note that the portions of the report printed in italic type are recommended by the Committee for inclusion in the MANUAL. If it is satisfactory to the members present we will read such portions which are printed in italic type and move them for adoption. The first portion to be so printed reads as follows:

Whenever conditions will permit, thoroughly air season all structural timber, track ties, piles and other materials before treatment. So far as practical arrange delivery of material so that the seasoning period may be during seasons of minimum rainfall and humidity.

MR. A. R. JOYCE: I move you that this paragraph be adopted by the Association.

MR. E. W. BRIGHT: I second the motion.

THE PRESIDENT: Gentlemen, you have heard the motion. Any remarks? All those in favor of adopting this paragraph signify it by saying "aye"; contrary, "no." The motion is carried.

MR. A. R. JOYCE: The next section reads as follows:

The seasoning yard should be in the open where the prevailing winds will strike it freely; should not be in a low and humid situation of any kind if it can be avoided; should have good drainage; and should be kept free from weeds and grass and decaying wood material.

All outer bark should be removed before treatment, and in most cases before seasoning. Also as much of the inner bark should be removed as practical, and in no case should over 10% or strips over 1 in. wide and 6 ins. long be left.

When there is not sufficient time for proper air seasoning, or, in the case of piling and large dimension timbers which will not air season successfully throughout without deterioration, artificial seasoning by steaming or boiling before treatment must be resorted to.

MR. A. R. JOYCE: I move you, Mr. President, that these paragraphs be adopted as read.

MR. E. W. BRIGHT: I second the motion.

THE PRESIDENT: Any remarks? All those in favor of this paragraph signify it by saying "aye"; contrary, "no." The motion is carried.

MR. A. R. JOYCE: On page 415 we recommend as follows:

In treating with creosote, it is recommended that a maximum injection of creosote sufficient to insure the penetration of all treatable wood be required. All of the sapwood and as much of the heartwood as is possible for the particular species shall be thoroughly impregnated. This applies equally to full-cell and empty-cell treatments.

In treating with zinc chloride it is essential that all timber be treated to refusal.

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I move you, Mr. President, these be adopted as read.

MR. F. W. CHERRINGTON: I second the motion.

THE PRESIDENT: Any remarks? All those in favor of adopting this paragraph signify it by saying "aye"; contrary, "no." The motion is carried.

MR. A. R. JOYCE: On page 415:

Wherever possible, all timber should be framed before treatment, and in lieu of this unimpregnated wood exposed by framing after treatment should be thoroughly painted with hot creosote.

To secure the best results it is necessary to protect treated material from mechanical abrasion both in handling and under service conditions.

I move you, Mr. President, these be adopted as read.

MR. WALTER BUEHLER: I second the motion.

THE PRESIDENT: All those in favor of adopting these paragraphs will please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. A. R. JOYCE: At the top of page 416:

A penetration of ½ in. on the heart faces may be recommended as a safe minimum on structures above ground.

I move you this be adopted as read.

MR. NELSON C. BROWN: I second the motion.

THE PRESIDENT: All those in favor of adopting this paragraph please signify it by saying "aye"; contrary, "no." It is adopted.

MR. A. R. JOYCE: At the top of page 416:

Where strength is required, not only the defects which might reduce the strength but also the quality as determined by density should be specified; but where strength is not an essential only the soundness of the timber and the sapwood requirements as determining penetrability need be considered.

I move that this be adopted as read.

MR. F. W. CHERRINGTON: I second the motion.

THE PRESIDENT: All those in favor of adopting this paragraph please signify it by saying "aye"; contrary, "no." The motion is adopted.

MR. A. R. JOYCE: On page 421 under Piles:

I move this be adopted as read.

Piles for use in salt water where ravages of marine borers are extremely severe: Specify not less than 2½ ins. of sapwood, nor more than 5 inches.

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MR. WALTER BUEHLER: I second the motion.

THE PRESIDENT: All those in favor of adopting this paragraph please signify it by saying "aye"; contrary, "no." It is adopted.

MR. A. R. JOYCE: On page 421:

Piles for use in salt water where ravages of marine borers are less severe than in Group 1: Specify not less than 1 in. sapwood, nor more than 3 inches.

I move this be adopted as read.

MR. GEO. E. REX: I second the motion.

THE PRESIDENT: Gentlemen, there are quite a number of these recommendations, and unless there are some objections raised, I do not see any reason why we should put the motion every time. We will have the motion made and seconded and declared adopted, unless there are some objections, if there is no opposition to this ruling. Are there any objections to this paragraph as read? If not, it is considered adopted.

MR. A. R. JOYCE: On page 421:

Piles for use in fresh water or foundation work on land: No sapwood restrictions are necessary.

I move the adoption of this paragraph as read.

MR. LOWRY SMITH: I second the motion.

THE PRESIDENT: Are there any remarks? If there are no objections this paragraph will be considered adopted.

MR. A. R. JOYCE: At the bottom of page 422:

Support all piles on treated sill ties, and in all cases at least 6 ins. of air space should be allowed underneath. To allow proper air circulation, the alleys between the piles should extend in continuous lines across the seasoning yard and should be not less than 5 ft. in the working spaces and 1 ft. in other directions.

In a moist climate and under humid conditions, season all material in open piles, which will provide free circulation of air and exposure to the sun. Place a close slanting roof of ties over all piles. By open piles is meant the common 1x7, 1x8 or 7x2 piling system, or other arrangement which gives a minimum contact and the maximum of open spaces between the ties. Insist that the stringers be placed as near the end of the ties as possible, then in case of any defects from contact they will not fall upon the rail bearing. In arid climates with low humidity, season in close piles to prevent checking and warping.

I move the adoption of these paragraphs as read.

MR. J. B. CARD: I second the motion.

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MR. O. C. STEINMAYER: I do not see what the intent of the Committee is when it says "5 ft. in the working space and 1 ft. in the other directions" in piling ties. Just what did the Committee have in mind?

MR. LOWRY SMITH: Why, I think what is meant there is the two systems of piling across the yard, either the continuous system or individual piles. By dividing by 1 ft. it means the space between the individual piles, not the tiers of ties. It is customary in some places to pile individual piles and in some to continuously pile them in one tier.

MR. O. C. STEINMAYER: It seems to me that 5 ft. is entirely too large a distance to make a minimum width of alley, because it would take entirely too much yard space, and I hardly think that amount of alley space is necessary where the ties are not piled excessively high. It is my idea that the necessary width of alley between piles is dependent upon the height to which the material is piled, to get the best seasoning conditions, and to avoid loss from excessive checking due to rapid seasoning. It seems advisable, therefore, that the minimum width of alley should be 3 ft., which will allow a person to get in between the piles and observe the conditions of the timber in piles during the seasoning period.

MR. F. J. ANGIER: Mr. President, I want to go on record as agreeing with Mr. Steinmayer on 3 ft. between piles. We have been piling ties for about 15 years and have never used more than 3 ft., and we find this ample, not only for seasoning, but for getting between to put in "S" irons and to do other work. I think it takes altogether too much room to make it 5 ft.

Also another sentence in the last paragraph, in which it says, "Place a close slanting roof of ties over all piles." This may be all right theoretically, but as a matter of fact it is not done and will not be done at a timber-treating plant that is handling millions of ties a year, and I do not see the necessity for it.

MR. E. H. BOWSER: I agree with Mr. Angier on that. I do not think you ought to roof the ties. What you prevent is the water getting into the middle of the pile. When you have that roof slope you get a great deal more water on one end of your pile of ties than the other, and those ends of the ties will decay much quicker and the seasoning conditions are very different from the other parts of the ties. I believe you ought to leave it open and not put the roof on. I think it is better without the roof, so the ties will season more evenly.

MR. F. J. ANGIER: Mr. President, if I am in order, I would like to make an amendment to the motion that in the first paragraph 5 ft. be changed to 3 ft., and in the second paragraph to omit that sentence reading, "Place a close slanting roof of ties over all piles."

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MR. E. H. BOWSER: I second the motion.

THE PRESIDENT: Are there any remarks on this amendment? If not, gentlemen, you have heard the amendment. All those in favor please signify it by saying "aye"; contrary, "no." The amendment is carried. As the motion now stands amended, are there any further remarks? If not, all those in favor——

MR. C. E. GOSLINE: Would it not be a good idea to suggest there just what is meant by "the other way"; to state between what that 5-ft. alley or the 3-ft. alley is? As it is now we do not know whether it is parallel or at right angles to the track.

MR. O. C. STEINMAYER: As it is now, the 3 ft. of alley is the minimum width. It does not make any difference what direction it is; it is just an alley of 3 ft. I do not think that would be misinterpreted.

MR. LOWRY SMITH: It is a continuous arrangement across the yard. What does "across the yard" mean? It does not mean lengthwise.

MR. O. C. STEINMAYER: You have a minimum distance that you must pile your ties from standard gauge tracks. No use for us specifying that because it is specified by other authority.

THE PRESIDENT: Are there any further remarks? Are you ready for the question? All those in favor of adopting this paragraph as read, with the amendments which have just been adopted, will please signify it by saying "aye"; contrary, "no." The paragraph as amended is adopted.

MR. A. R. JOYCE: In the last paragraph on page 422 we have the following:

Both gum and beech should be seasoned only in wide open piles and watched very carefully for dry rot.

I move the adoption of this as read.

MR. F. J. ANGIER: I second it.

THE PRESIDENT: Any remarks? This paragraph as read is considered adopted.

MR. A. R. JOYCE: At the beginning of the third paragraph on page 423 we have the following:

Ties and timbers which have a tendency to check should be protected with "S" irons, or other devices.

I move the adoption of this as read.

MR. F. J. ANGIER: I second it.

THE PRESIDENT: Any remarks?

MR. O. C. STEINMAYER: Mr. President, what is the idea of specifying the kind of rot that you should guard against in beech and

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gum? The Committee's recommendation reads: "Both gum and beech should be seasoned only in wide open piles and watched very carefully for dry rot?" What is the idea of specifying the kind of rot?

MR. A. R. JOYCE: Mr. President, we are perfectly willing to take the "dry" out of the rot.

MR. O. C. STEINMAYER: Why not say "decay" for "rot"?

THE PRESIDENT: Are there any remarks on the sentence which has just been read regarding "S" irons? If not, this will be considered adopted.

MR. A. R. JOYCE: In the middle of the third paragraph on page 423 we have this sentence:

All ties should be bored and adzed before treatment.

I move the adoption of this as read.

MR. GEO. E. REX: I second the motion.

MR. E. H. BOWSER: I would suggest that you put in there, "if the conditions justify it."

MR. O. C. STEINMAYER: Mr. President, why not add "as far as practicable"? There are a great many ties produced on rivers and streams that have nails driven in them to aid in the rafting and driving of those ties. I do not think it would be feasible to run such ties through a tie adzing and boring machine. If the clause read, "as far as practicable," that objection would be overcome. There are several million ties received from rivers which would have these nails in them, so this is something worth while.

MR. C. E. GOSLINE: Mr. President, the way to overcome that would be to educate your tie-rafting people to nail your strips closer to the ends of the ties.

MR. E. H. BOWSER: What I have reference to, if you have long stretches on your road, where the rail changes every two or three miles, it is impractical to ship bored ties to the section foreman, because you will never get them in the right place. You will have to have considerable stretches of the same kind of rail base before you can do the boring, unless you have special tie-plates that will hold any rail with the same spacing of spikes.

MR. A. R. JOYCE: The sentence as framed here does not say, "All ties must be under penalty," it says, "All ties should be."

MR. O. C. STEINMAYER: Why not put in there, "so far as practicable all ties should be adzed and bored before treatment"?

MR. A. R. JOYCE: The qualifications do not make any difference.

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MR. O. C. STEINMAYER: I cannot understand how you can run some rafted ties through tie adzing and boring machines. You know, Mr. Smith, you would have to explain it in a way. I have found you can't get contractors to handle it.

MR. A. R. JOYCE: That is the point.

MR. GEO. E. REX: I would like to say that we have had that experience, and I think all of you agree with me that there is no tie that needs that boring and adzing any worse than those rafted ties, those ties that have laid in that river until we often do not know how long they have been out, and there is no way of telling, and under bad conditions, and those are the ties of all ties that do need the boring and adzing. While it is true that there are some nails, and you run your bits and saws through them, but, as Mr. Gosline suggested, they should be educated to get away from them just the same as we find it difficult to get our contractors to mark our ties for inspection, but we do not get away from it, we do not let them get away from it because it is a trouble. I think they should be educated to put their nails in the right place, and not put them where you will ruin your boring and adzing machine.

MR. E. A. STERLING: Mr. President, the Committee, as I understand it, was simply stating a broad principle. It does not mean you must do that, or anything of the kind. The need certainly exists in spite of the fact that there may be local conditions or circumstances which would prevent doing it. It is simply the idea of the Committee to state this as a principle. I think we all agree that as a principle it is sound.

THE PRESIDENT: Any further remarks? If not, there are no amendments to the motion, and therefore I will put the motion. All those in favor of adopting this sentence as read will please signify it by saying "aye"; opposed, "no." The motion is carried.

MR. A. R. JOYCE: A little farther down in the same paragraph on page 423, we have this sentence:

If possible, all timbers should be framed before treatment.

I move the adoption of this sentence as read.

MR. H. M. ROLLINS: I second the motion.

THE PRESIDENT: Any objections?

MR. C. E. GOSLINE: I think the "if possible" should be cut out of that.

MR. A. R. JOYCE: We will cut that out.

THE PRESIDENT: If there are no further objections, the motion will be considered as carried.

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MR. A. R. JOYCE: The second paragraph occurring on page 423:

Oak ties should be given a minimum of eight months seasoning, and should preferably be seasoned 12 months; yellow pine if seasoned in the south 4 to 6 months; hemlock, tamarack and jack pine 12 months; gum, beech, birch, and hard maple from 4 to 6 months.

I move the adoption of this as read.

MR. GEO. E. REX: I second the motion.

THE PRESIDENT: Are there any objections?

MR. O. C. STEINMAYER: I can imagine the condition of a red oak tie that was cut in the month of November and only 8 months afterward an attempt was made to treat it. I do not think it would be very well treated. Would it not improve this paragraph to say "8 seasoning months"? There is little seasoning occurring in the months of November, December, January, February, March.

MR. LOWRY SMITH: It would not be seasoning then, would it?

MR. O. C. STEINMAYER: It is seasoning more or less, but it would not be time enough for treatment.

MR. H. M. ROLLINS: Mr. President, I would like to know what the Committee means to include under the phrase "southern yellow pine"? Whether it means to include all southern yellow pines? Because, if it does, I think the period of four to six months should be modified to some extent. I would suggest that that be cut to 90 days on loblolly pine.

MR. J. H. WATERMAN: Mr. Chairman, is 4 months enough for beech, birch and maple? It looks to me as though beech, birch and maple are about as hard to season as red oak, especially hard maple. I am with the Committee, I will vote for whatever it says is the proper thing here, but I would like to call attention to that.

MR. WALTER BUEHLER: Mr. President, I think the difficulty of trying to season beech, for instance, longer than say 4 months, that coming from Kentucky, Tennessee or any of the southern points, is that the sapwood begins to rot if you hold it longer than that period. That has been our experience in a number of cases, that when ties got to us treated we in some cases found that the sapwood of beech had already rotted. It probably had been held at the seasoning yard too long. You do not get very much treatment into the heart of a red beech tie, and if you can get the sapwood seasoned, and I think you can get it seasoned in 4 months, I believe that is about as long as it is advisable to hold the wood for seasoning. In the case of beech, and I believe maple, that would be somewhat the same proposition.

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MR. J. H. WATERMAN: Mr. President, you have had more experience than any man in the world on that. What is your judgment?

THE PRESIDENT: On beech, birch and maple?

MR. J. H. WATERMAN: Yes.

THE PRESIDENT: My idea is that they should be seasoned 6 to 8 months.

MR. G. S. HARDEN: Mr. President, I want to agree with you on that. The most of our ties are beech and maple and it has been our experience that they require at least 6 months' seasoning. They have to be watched very carefully for indications of rot during this period.

MR. NELSON C. BROWN: Mr. President, I would like to ask the Committee if any data were secured on other forms of ties, such as fir and chestnut, which are used in very large quantities? I would like to know if any data were secured on those species in particular.

MR. L. T. ERICSON: Mr. President, I believe the Committee is wrong in trying to establish a uniform period of seasoning for ties in various parts of the country where the conditions are so dissimilar as they are in this country. I think it is preferable to determine whether the tie is ready to treat by making laboratory tests of the borings to determine the moisture content. In connection with seasoning, the length of time should always be governed largely by making tests of borings for moisture content, and it should be remembered that the moisture content will vary in different species of wood; so that while 20% of moisture content in pine will probably be correct in one locality, in that same locality perhaps oak cannot be air-seasoned to less than 30% moisture content.

THE MEMBERS: Question, question.

THE PRESIDENT: Gentlemen, in my opinion this is a rather important matter, and I think it should be pretty well considered before it is adopted. We have had a great many suggestions here showing that the members of our Association are not of one mind. I would like to see this subject given further consideration.

MR. C. E. GOSLINE: Mr. President, I think we are on the wrong track on this seasoning proposition. Previous to this paragraph there should be stated some remarks as to the period of cutting and then reckon your seasoning months by the cutting. It is apparent there is some disagreement as to the number of months that each specie should be seasoned, and, therefore, I move you that this paragraph be cut out.

MR. O. C. STEINMAYER: I second that motion.

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MR E. A. STERLING: Mr. President, the Committee has had a little informal discussion here, and it feels that a clause should be added, to the effect that the periods mentioned refer to seasoning months, that is the months in which seasoning would occur; summer months, in other words.

MR. H. M. ROLLINS: Mr. President, that term "seasoning months" is not clear. I would like you all to recall what we saw on the screen this afternoon, slides showing ties that were placed in yards for seasoning in June, showing that those ties were decayed in November. Those were southern yellow pine. Now, if in the five months those ties are decayed, that is proof positive that 6 months would be too long. I do not think that that clause ought to go in as it is written in the recommendation.

MR. A. R. JOYCE: Would 3 to 6 months be satisfactory?

MR. H. M. ROLLINS: I would like to see it not more than four months.

MR. J. H. WATERMAN: A man in the north might want more.

MR. GEO. E. REX: I would just like to say to Mr. Rollins, that as you all know there are a great many kinds of yellow pine, and there is no reason in the world why longleaf yellow pine could not stand 8 months, while loblolly pine will stand 6 months all right if cut in certain months of the year. It might be beyond the question to put this limit on, but I think we do not expect to make a limit for a man to follow in a particular kind of a tie. If he has a tie that decays in six months, we do not expect him to use this long limit for that particular kind of tie, whereas he could leave the longleaf ties that long. This is to cover all kinds of ties. I think it is well taken. Personally, I would not object to seeing the minimum reduced to ninety days under proper conditions, but the specification there as written covers all the different kinds of ties, both the longleaf and the loblolly.

MR. O. C. STEINMAYER: Mr. President, I have seen some loblolly ties treated that were seasoned but 60 days. It is rather impractical to specify the number of months any species of timber should be seasoned. Mr. Eriscon made a recommendation about the moisture content. I think that is a very good one. I do not think it is possible to specify the number of months that you ought to season any timber under the varying conditions existing throughout the country. We have so many unknown quantities.

THE PRESIDENT: Gentlemen, if there are no further remarks, I will put the question, with the amendment that the Committee has already accepted. All those in favor of adopting this part of the report as just read and amended by the Committee will please signify

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it by saying "aye"; contrary, "no." I will have to ask you to stand up, and those of you who are interested in seasoning ties and have opinions on this I would like to have you vote.

MR. WM. A. FISHER: Can we have it read again, please?

THE PRESIDENT: Yes.

MR. A. R. JOYCE:

Oak ties should be given a minimum of 8 months' seasoning, and should preferably be seasoned 12 months; yellow pine, if seasoned in the South, 3 to 6 months; hemlock, tamarack and jack pine, 12 months; gum, beech, birch and hard maple, 4 to 6 months.

The reference above is to the seasoning months of the year.

MR. M. K. TRUMBULL: I think it is just about as essential that 3 to 6 months be used for gum as for pine. What is your opinion, Mr. Rex?

MR. GEO. E. REX: Well, I do not know. I would not like to undertake to treat any gum ties in three months.

MR. M. K. TRUMBULL: Short of three months?

MR. GEO. E. REX: I would not like to undertake to treat them if they only had 3 months' seasoning.

MR. M. K. TRUMBULL: I have seen gum ties go just as quickly as pine ties, at times.

MR. GEO. E. REX: That is true, but you also must remember if you get good treatment you have to have the water out of them and the water does not come out of gum ties as it does out of pine ties. I personally would not like to treat gum ties in 3 months.

THE PRESIDENT: All those in favor of the motion as just read by Mr. Joyce will please stand up. (17 stood up.) All those opposed will please rise. (6 stood up.) The motion is carried. That part of the report is adopted.

MR. A. R. JOYCE: Near the middle of page 423:

All efficient plants should be equipped to steam material which occasion requires.

I move the adoption of this paragraph as read.

MR. F. J. ANGIER: I second the motion.

THE PRESIDENT: Any objections? If not, this is considered adopted.

MR. A. R. JOYCE: At the top of page 424:

In steaming the pressure should at no time exceed 20 lbs. per square inch, nor the oil temperature in boiling exceed 200° F. with possible exceptions in the case of some Pacific Coast timbers which may require higher temperatures.

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I move the adoption of this paragraph as read.

MR. E. A. STERLING: I second the motion.

THE PRESIDENT: Any remarks?

MR. WM. A. FISHER: It seems to me that the limit of pressure allowed is hardly high enough to cover all timber that it may be desired to treat. There are undoubtedly some classes of timber that it is necessary to steam higher than 20 lbs. in order to get the desired impregnation. I feel that this limit as allowed is possibly 10 and may be 15 lbs. lower than might well be allowed for some timber that can stand that much steam pressure.

MR. H. M. ROLLINS: Mr. President, I would like very much for the Committee to add in the exceptions, longleaf pine along with Pacific Coast timber.

THE PRESIDENT: All those in favor of the motion to adopt this paragraph as read will please signify it by saying "aye"; all those opposed, "no." That is not a very strong vote, gentlemen.

MR. O. C. STEINMAYER: Do we understand the Committee has looked favorably to the recommendation made by Mr. Rollins?

THE PRESIDENT: The Committee does not see fit at this time to accept it.

MR. H. M. ROLLINS: I should like to add, if I am in order, that the Lighthouse Service specify merchantable longleaf pine, and they also specify an injection of 20 lbs. of oil to the cubic foot of timber. Now, I do not believe that it is possible to accomplish what their specifications call for with a maximum temperature that you would get with 20 lbs. steam pressure, and in view of the fact that the different United States Engineers' offices distributed along the Gulf Coast and the United States Lighthouse Service demand that class of material and that amount of oil injected, I think it well to go rather slow in limiting the maximum temperature that may be used in treating timber which we all know in years gone by has been subject to those high temperatures. It does not apparently result in any great injury to the timber, and it certainly does allow the injection of the required amount of oil.

THE PRESIDENT: Gentlemen, I am quite sure that there are more than two or three men in the room who have steamed timber and treated timber, and have some pretty good ideas on this question, at least ideas sufficiently definite to vote on the question. I am not going to accept the vote as taken, with yea and nay, but I am going to ask a vote on this question again and ask you to stand up. All those in favor of this motion as read will please rise to their feet.

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MR. M. K. TRUMBULL: Mr. President, I would like to explain my vote. It is the understanding that 20 lbs. steam-pressure is gauge-pressure, that is pressure below the atmosphere.

MR. A. R. JOYCE: Steam-gauge pressure.

THE PRESIDENT: All those opposed will please rise to their feet. The motion is carried.

MR. A. R. JOYCE: At the bottom of page 424, the Committee recommends the following:

> *The use of the full-cell process for piles and other marine timbers where subject to attack of the teredo and other marine borers, and that in such situations an injection of at least 20 lbs. per cubic foot, or treatment to practical refusal, should be given; while in marine and land situations where decay is the principal source of failure, treatments may range down from 20 to 10 lbs. per cubic foot by the same process, the injection in all cases to be sufficient to penetrate all the sapwood.*
>
> *The full-cell treatment in permanent structures not subject to mechanical wear when conditions of moisture, climate or humidity are favorable to wood-destroying fungi, and particularly where the cost of renewals or replacement would be high.*

I move the adoption of these as read.

MR. J. H. WATERMAN: I second the motion.

THE PRESIDENT: Are there any objections? If not this part of the report is considered adopted.

MR. A. R. JOYCE: At the bottom of page 425:

> *In all outside situations it is recommended that a maximum injection of creosote, or sufficient to insure the penetration of all treatable wood, be required and that not less than an average of 5 lbs. of creosote per cubic foot be left in the treatable portions of the wood; while it is urged as a definitely specified requirement, that at least all of the sapwood and as much of the heartwood as is possible for the particular species shall be thoroughly impregnated, and the depth or extent of the penetration be equal to that of the full-cell treatment.*

I move the adoption of this paragraph as read.

MR. GEO. E. REX: I second the motion.

THE PRESIDENT: Are there any objections to this paragraph?

MR. W. F. GOLTRA: I would like to inquire if the recommendation that a "maximum injection of creosote or a sufficient quantity to insure the penetration of all the treatable wood" is not identically the same thing as treating to "refusal"? If we do not treat to refusal, how

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can we attain the object of this recommendation? The same question applies to Article IV, where we say:

> In treating with creosote oil, it is recommended that a maximum injection of creosote sufficient to insure the penetration of all treatable wood be required.

Then we go on and say when

> Treating with zinc chloride, it is essential that all timber be treated to refusal.

I am unable to see the difference between the two. I do not understand how it is possible to inject a maximum amount of creosote oil or zinc chloride into the timber unless it is treated to refusal. And, conversely, if the timber is not treated to refusal, no matter what kind of preservative is used, we are not giving it a maximum injection and the result is only a partial treatment.

THE PRESIDENT: All those in favor of this paragraph being accepted will please signify it by saying "aye"; opposed, "nc." The motion is carried.

MR. A. R. JOYCE: On page 426:

> *Where zinc chloride alone is used it be by the standard process known as Burnettizing, and that a full impregnation which will insure the retention of a minimum of ½ lb. of dry salt per cubic foot of timber be given.*
>
> *We suggest zinc chloride treatment in arid and semi-arid regions, particularly for cross-ties and other material with mechanical life limited to the expectation of life from decay and checking; also for woods resistant to creosote. It should not be used where mechanical wear is eliminated, nor in situations where the treated timber is in permanent or intermittent contact with either stagnant or flowing water. Consideration should also be given to its use on overhead trestles and similar structures.*
>
> *Under usual conditions three months' seasoning after treatment is advisable.*

I move the adoption of these paragraphs as read.

MR. GEO. E. REX: I second the motion.

MR. E. H. BOWSER: I move we omit the paragraph, "Also for woods resistant to creosote."

THE PRESIDENT: Did you make that as a motion?

MR. E. H. BOWSER: Yes.

MR. WM. A. FISHER: I second the motion.

MR. GEO. M. HUNT: Mr. Chairman, I think it can be definitely proven that zinc chloride will go into certain woods easier than creosote. I have not the data here to show, but it can be shown that zinc chloride will go into some woods much better than creosote.

MR. E. H. BOWSER: I would like to hear Mr. Rex on that.

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THE PRESIDENT: Has Mr. Rex anything to say? Are you ready for the——

MR. A. R. JOYCE: Mr. President, there are some very interesting facts available in connection with certain species of woods, which apparently are not more resistant to creosote than to an aqueous solution, but I think the Committee is willing to accept Mr. Bowser's amendment and strike from the paragraph "Also for woods resistant to creosote."

MR. O. C. STEINMAYER: Mr. President, I should like the Committee to consider the substitution of "treatment" for the word "it," in the second line. The clause would then read:

> We recommend where zinc chloride alone is used treatment be by the standard process known as Burnettizing.

MR. A. R. JOYCE: We accept that, Mr. Steinmayer.

THE PRESIDENT: Are there any further remarks?

MR. M. K. TRUMBULL: Mr. President, I would like to raise just one question, and that is of phraseology. Would it not possibly be a little better to say "it is recommended" than as printed, "we recommend"? The same wording appears several places before this.

MR. A. R. JOYCE: That is satisfactory.

THE PRESIDENT: That is a very good point for the Editor. Gentlemen, the Committee has accepted the corrections suggested by Mr. Bowser and by Mr. Steinmayer, as well as that by Mr. Trumbull. All those in favor of adopting this part of the report will please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. A. R. JOYCE: The final paragraph on page 426:

> *Creosote-zinc in mixture is fundamentally effective because composed of the two most widely accepted preservatives. In situations where the mixture is preferable to a single preservative, it should be used according to the judgment of the consumer as to its greater economy and efficiency under local conditions.*

I move the adoption of this paragraph as read.

MR. GEO. E. REX: I second the motion.

THE PRESIDENT: Any remarks? If not, this motion is carried.

MR. A. R. JOYCE: Mr. President, I move you that the balance of this report be accepted as information by the Association.

MR. LOWRY SMITH: I second the motion.

THE PRESIDENT: All those in favor of accepting the remainder of this report be accepted as information by the Association.

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MR. LOWRY SMITH: I second the motion.

THE PRESIDENT: All those in favor of accepting the remainder of this report as information please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. J. H. WATERMAN: Mr. President, I move you we compliment the Committee on the work it has done.

MR. J. C. WILLIAMS: I second the motion.

THE PRESIDENT: I just want to hear Mr. Shanesey.

MR. M. T. SHANESEY: Mr. President, in looking over the report presented by Committee on Specification for the Purchase and Preservation of Treatable Timber, it will be noticed that a great deal of emphasis is placed on the necessity for having good drainage in the seasoning yard, which it is recommended should not be in a low or humid situation. It is also generally understood that only perfectly sound timber should be treated.

These views are no doubt most heartily approved. I am of the opinion that it would be advisable to make this policy more expansive and apply it at least to some extent in the tie and timber producing fields and at points where material of this kind is loaded for shipment.

After observing the convincing pictures displayed here today by Mr. Waterman and Mr. Rex, in which the inadvisability of accepting anything but perfectly sound timber has been clearly demonstrated, it certainly appears absolutely necessary that a campaign of education should be introduced among producers and the greatest publicity given by purchasers and those interested in the treatment, as to best methods of piling and care which should be given ties and timber so as to lessen the liability of material becoming defective while it is being held for shipment.

If proper drainage and certain methods of piling are good things at the seasoning yards, it is very evident that there is room for improvement at the loading points where ties are accumulated for shipment.

From observations taken I feel that not only the members who are interested in the purchase and inspection, but also those employed in connection with the treatment, are vitally interested in securing some improvement in the way of proper care being given ties and timber from the time manufactured until placed on cars for shipment to the treating plants.

There are times when, through car shortage, or inability to get labor, that ties are held at the loading points for several months, and, if not properly piled, soon become defective. The manner of piling

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should be standardized so that, if for any reason the producers are forced to hold ties for an indefinite length of time, they would not deteriorate, thus eliminating or at least minimizing the loss which is being sustained not only by purchasers but also producers and which ultimately would be immensely profitable to all concerned.

It being generally understood that there is no justification for treating anything but sound timber, it would seem that some method should be applied to lessen the liability of ties in an incipient stage of decay being accepted.

All of the purchasers employ inspectors to see not only both ends but all sides of each and every tie before rejecting or accepting them.

Under existing conditions some of the producers make a practice of standing the ties on ends in yards which have no drainage whatever, where after rains the ties are nearly, if not entirely, surrounded by mud and water.

When these yards dry out to an extent where it is possible for an inspector to get to the ties, it is found that their ends which have been in contact with the soil, are covered with mud and sometimes with ice and snow, so that the condition of ties cannot be determined on account of moisture conditions.

From examination which has been made of ties which have stood on ends and were later shipped to treating plants for seasoning, it was found that when the sun would melt the ice and snow, or rain would wash the mud from the ends, decay would be disclosed. Not being sound, such ties would be relegated to the cull pile and either sold for construction ties at considerable loss or destroyed as worthless on account of being unfit for any use.

The inspectors concerned are not so much to blame in such cases as their superiors who permit them to inspect under conditions where it is impossible for them to observe or discern the defects which are entirely concealed by the mud adhering to the ties from contact with the soil.

Some of the railroads, realizing the possibility of serious loss, are so strongly opposed to accepting ties stacked on ends that they are refusing to accept them, while others have served notice on contractors and producers that after certain dates ties piled in this way will not be accepted.

The fact having been most firmly established that, if ties are not given proper care at loading points, they will soon decay and as there is no better way to protect the future than by applying experience previously gained and as just about all purchasers and inspectors are united in the belief that it is a very bad practice to stand ties on ends, I

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therefore move for inclusion in the MANUAL OF RECOMMENDED PRACTICES, the following:

Ties or timber which have been allowed to stand on their ends should not be accepted.

MR. F. J. ANGIER: Mr. President, I would like to second that motion and would like to have our Chief Inspector, Mr. Rowland, make some remarks on it.

MR. J. R. ROWLAND: Being out of the hall for a few minutes, I did not hear the first of Mr. Shanesey's remarks, but heard all he had to say about making inspection of cross-ties piled on end, and I agree with him on every remark he made. We have been having considerable trouble in making inspections of cross-ties standing on end in Kentucky, Ohio and Tennessee territory. We find it is impossible to secure real good ties when they are piled in this manner, on account of the fact that a great many are piled in mud holes or pools of water which makes it impossible for an inspector to see the end of the ties that rests on the ground as this end is usually covered with mud or dirt during warm weather and is covered with ice during the winter months. On this account we occasionally accept bad ties as our inspectors' sight cannot penetrate to the ends of such ties through this mud, dirt or ice as the case might be, and where conditions in tie yards where this method of piling is practiced are very bad the chances are that a great many inferior ties will get by the inspector no matter how careful he is.

It has only been a few days since I was out on our line looking up a carload of ties when I accidently ran across another load of ties that had been unloaded at the point I visited and in looking over these ties I readily discovered they had been piled on end and that the inspection had been made while they were piled in this manner. In looking over these ties, of which there were 410, I found nine with badly rotten ends with mud and dirt still clinging to them which had been accepted as Grade 1, but should have been rejected, and this inspection was made by one of our best and most careful inspectors who I am sure would have rejected these ties could he have seen the ends. This I think proves conclusively that proper inspection of ties standing on end cannot be made, and like Mr. Shanesey, I believe the practice of piling ties in this manner should be broken up everywhere, not only in the territory mentioned, but every place where we find ties piled in this manner. We have also had a great deal of trouble in making inspections of ties during the winter months when piled on end as we find them frozen together and have to be pried apart with bars. I have been on piles of ties standing on end that were so solidly frozen together that it required two men with steel bars to pry them apart. This is another drawback in making inspection of ties piled on end.

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I think all cross-ties in foreign territory should be piled in ricks or square piles, and on a road's own right-of-way they should be piled in accordance with that particular road's specifications. This gives inspectors a chance to see both ends, sides and faces, and enables them to make a thorough inspection, which cannot be done with ties piled on end. I think the method of piling cross-ties on end should be discouraged not only by contractors and buyers, but also by inspectors, and in fact, by every person interested in the cross-tie business. I believe also that contractors and buyers should be given notice that after a reasonable time no ties would be inspected that are piled on end, and after the expiration of such time the different railroads throughout the country should discontinue inspecting ties found piled on end.

THE PRESIDENT: Are there any further remarks on this motion?

MR. E. H. BOWSER: We do not attempt to inspect ties, either on end or in ricks without re-handling. When it comes to inspection it does not make any difference which way they are piled.

MR. O. C. STEINMAYER: In the South in a great many places, where the tie production is very heavy, the only way tie contractors can get their ties close to the station to handle them from side tracks is by putting them on end. That is the explanation they have given me. They do not believe in the practice themselves, but they are short of room and by standing them on end they can get a great number of ties in a minimum area. I believe it would be a good thing for this Committee to make a recommendation to the effect that all ties be moved to a seasoning yard as soon after cutting as possible, so that the ties can be seasoned under proper supervision.

MR. F. J. ANGIER: Mr. President, I would like to say a word on that. We have experienced a good deal of difficulty in inspecting ties piled in this manner. We find that in some places ties have been standing on end as long as six years before they can be taken up. This is brought about from the fact that they start to pile these ties on end and keep on adding to the pile round and round until they have a pile perhaps of several thousand. We all know how the car situation is. We have cars sent there and can only load up a few of those ties. The outer ties are loaded. Before our inspector can get around and take up more ties, additional ties are stood on end around this core, and the result is that the inside is left there for years and decay sets in and surely the decayed ties in the center do not do the outside ties any good. I think that it is a bad practice and should be broken up.

THE PRESIDENT: If there are any other remarks that you feel will throw light on the subject I will be glad to give you the time if you will make your remarks brief. If not, I will put the motion.

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MR. E. H. BOWSER: I do not agree with them as to the time. There should be a limit of time about standing ties on end. Sometimes you bring them out of the river, place them on end and keep right on loading them. It means only two or three days in this position, and when they are put on good ground it does not hurt them at all.

MR. F. J. ANGIER: You cannot get your inspectors there always on the date you get your cars.

MR. M. T. SHANESEY: In most cases ties are stood on end in order to facilitate the work of unloading, on the part of the producers. They drive the wagon up to the loading point, where the ties are accumulated for shipment, and pull one end off and up-end the tie, which, of course, lessens the expense of loading. As Mr. Angier just said, cases have been discovered where in a large accumulation of ties a great many have been in the yard for several years. Now, it would appear to be immensely profitable to all concerned if something was done in the way of standardizing the piling of the ties.

For instance, the inspector goes out to the loading point to take them up, and, of course, he knows as a matter of common knowledge that ties that have been in contact with the soil soon become defective. Now, he looks over a lot of ties, and perhaps to outward appearances there are no defects discernible, but the very fact that they have been handled improperly would justify the belief that he ought to make a closer examination. He takes a saw and cuts off the ends of some of the ties that have been in contact with the soil, which reveals an incipient stage of decay. He rejects several thousand ties which if properly cared for would have been available for use on the different railroads. It is a crime for the railroads to lose them, and it is a crime for the producers to lose them, owing to improper handling. By discouraging the practice of standing ties on end it means that more ties will be available. There will not be so many relegated to the cull pile.

MR. F. S. POOLER: Mr. President, I want to say a word in connection with this. We purchase hundreds of thousands of ties every year along our right-of-way. They are delivered by small dealers mostly. A great many of them are white oak. I would not think of accepting ties piled in the manner which you mention. We do not even accept them piled in ricks, and the way to regulate that is by putting it in your contract. You can regulate it all right if you do that, and then if the inspector goes there and finds the ties are not properly piled, he can simply refuse to inspect them. That is simple. We have no trouble at all.

MR. J. H. WATERMAN: Mr. President, this motion is to encourage proper piling. You can make a contract, no matter what we do here. Mr. Pooler can go home and make a contract right opposite

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to this. We have not any strings on him, but as an Association we want to stand for high ideals.

THE PRESIDENT: Any further remarks? If you are ready for the question, all those in favor of the question please signify it by saying "aye"; all those opposed, "no." The motion is carried. I will be glad to recognize Mr. Waterman now.

MR. J. H. WATERMAN: I move you that we compliment the Committee on its efficient work, and hope that the next President will recognize it and give it an opportunity to do some more work.,

MR. F. J. ANGIER: I second the motion.

THE PRESIDENT: All those in favor please signify it by saying "aye"; contrary, "no." The motion is carried.

REPORT OF COMMITTEE ON SPECIFICATIONS FOR THE PURCHASE AND PRESERVATION OF TREATABLE TIMBER.

To the Members of the American Wood-Preservers' Association:

The portions of the report printed in italic type are recommended for inclusion in the MANUAL.

A.—Fundamental Principles.

1. Only perfectly sound timber should be treated.

Consideration of the effect of decay on the strength of wood is essential. Decay even when not very noticeable, may greatly reduce the strength value, and hence, with species which decay rapidly, but short service may result in a decided weakening.

2. In order to obtain the best results properly seasoned material should be used.

Preparing timber for treatment embodies mainly the various steps in the seasoning process, and is a very important factor in determining the ultimate value of the treated material. Owing to the wide diversity of conditions and the individual characteristics of the different woods, it is difficult to specify definitely under this heading.

Whenever conditions will permit, thoroughly air season all structural timber, track ties, piles and other materials before treatment. So far as practical arrange delivery of material so that the seasoning period may be during seasons of minimum rainfall and humidity.

Pile incoming material in its proper groups or classes, separating green from seasoned or partially seasoned material, and using successive portions of the yard for the storing of green timber.

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The seasoning yard should be in the open where the prevailing winds will strike it freely; should not be in a low and humid situation of any kind if it can be avoided; should have good drainage; and should be kept free from weeds and grass and decaying wood material.

All outer bark should be removed before treatment, and in most cases before seasoning. Also as much of the inner bark should be removed as practical, and in no case should over 10% or strips over 1 in. wide and 6 ins. long be left.

When there is not sufficient time for proper air seasoning, or, in the case of piling and large dimension timbers which will not air season successfully throughout without deterioration, artificial seasoning by steaming or boiling before treatment must be resorted to.

3. A good preservative is essential to long life.

COAL-TAR CREOSOTE.

From the standpoint of permanence and protection of wood against decay and marine borers, coal-tar creosote is the best available preservative for general purposes. It possesses the necessary theoretical requirements, and has stood all practical tests through many years' use under varying conditions of service and in many different kinds of material.

ZINC CHLORIDE.

Zinc chloride is of great importance as a preservative, and is the only mineral salt extensively used for wood preservation. It deserves full consideration in regions of low precipitation, in dry situations, and where low first cost is essential. It came into use in this country even before creosote, and has in most cases given service which fully justifies its application. While the life of zinc treated material is usually less than that of creosoted, the expense is also less, and the relation of cost to service is an important consideration.

FACTORS TO BE CONSIDERED IN COMPARING PRESERVATIVES:

(1). The toxicity of the preservative, namely, its ability to prevent decay.

(2). The ability of the preservative to penetrate the wood.

(3). The permanency of the preservative in the wood.

(4). The effect of the preservative on the strength of the wood.

(5). The effect of the preservative on the corrosion of spikes and plates, and the operation of block signals.

(6). The cost of the preservative.

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(7). The uniformity in composition of the preservative and ease of securing it.

(8). The combustibility of the preservative.

(9). The ease of handling the preservative and wood treated with it.

(10). The ease with which the penetration of the preservative can be determined.

Preservative treatments with creosote and zinc chloride when properly made, affect the strength of wood so slightly that any difference in crushing value is of little or no practical importance.

4. Proper injection as to quantity and penetration is essential.

In treating with creosote, it is recommended that a maximum injection of creosote sufficient to insure the penetration of all treatable wood be required. All of the sapwood and as much of the heartwood as is possible for the particular species shall be thoroughly impregnated. This applies equally to full-cell and empty-cell treatments.

In treating with zinc chloride it is essential that all timber be treated to refusal.

The treatment in the same cylinder charge of wood having great dissimilarity of permeability is not expected to give the best results until the treatment is carried to absolute refusal.

The time of treatment required to obtain absolute refusal varies in different species and with different seasoning, so much as to make serious delay in the case of the species of wood which have first reached totality waiting in the cylinder for the more refractory to obtain it.

5. Proper subsequent handling of timber is essential.

Wherever possible, all timber should be framed before treatment, and in lieu of this unimpregnated wood exposed by framing after treatment should be thoroughly painted with hot creosote.

To secure the best results it is necessary to protect treated material from mechanical abrasion both in handling and under service conditions.

6. Accurate records as to the life and cost of treated material are essential.

It has been the general experience that most satisfactory results are secured by maintenance of a limited number of intensive records of representative sections.

Two methods are in use for determining the annual costs of both treated and untreated material. One of these is the well-known amortization method, which involves the principle of compound interest; the other is a simpler method in which simple interest is used.

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B.—Selection of Treatable Timber.

1. Structural Timber.

The fundamental requirements of structural timbers for treatment are strength and capacity for treatment to an extent which will insure protection against decay on all exposed surfaces. *A penetration of ½ in. on the heart faces may be recommended as a safe minimum on structures above ground,* although with a few resistant woods as good a treatment as can be expected will show less than ½ in. penetration in the heart.

The strength requirement is determined by the species, and is further dependent upon the soundness, density of the wood, frequency, size and location of the knots, the extent, character and location of shakes and checks, and the character of the grain. Treatability in most woods is determined by the proportion and relation of heartwood and sapwood, with exceptions in the case of heartwood which takes treatment. *Where strength is required, not only the defects which might reduce the strength but also the quality as determined by density should be specified; but where strength is not an essential only the soundness of the timber and the sapwood requirements as determining penetrability need be considered.*

Since sapwood of like density and moisture content to heartwood, is also of like strength, the relative proportion of sap and heart on the same species may be considered from this standpoint.

While the mechanical properties of ties as with structural timbers are dependent upon the density of the wood, it seems neither practicable nor advisable at this time to propose density restrictions for tie specifications.

(a) RESTRICTIONS ON KNOTS, SHAKES, CHECKS AND CROSS GRAIN.

Adopt the specifications which were adopted during 1915 by the Southern Pine Association. These specifications should apply to all structural timbers where strength is a prerequisite.

> RESTRICTIONS ON KNOTS IN BEAMS. Shall not have in Volume 1 sound knots greater in diameter than one-fourth the width of the face on which they appear—maximum knot 1½ inches. Shall not have in Volume 2 sound knots greater in diameter than one-half the width of the face on which they appear—maximum knot 3 inches.
>
> The aggregate diameter of all knots within the center half of the length of any face shall not exceed the width of that face.
>
> The diameter of a knot on the narrow or horizontal face of a beam is to be taken as its projection on a line perpendicular to the edge of the timber. On the wide or vertical face, the smallest dimension of a knot is to be taken as its diameter.
>
> RESTRICTIONS ON KNOTS IN COLUMNS. Shall not have sound knots greater in diameter than one-third the least width of the column—maximum knots 4 inches.

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RESTRICTIONS ON SHAKES AND CHECKS IN BEAMS. Round or ring shakes shall not occupy, at either end of a timber, more than one-fourth the width of green material, nor more than one-third the width of seasoned material.

Any combination of checks and shakes which would reduce the strength to a greater extent than the allowable round shakes will not be permitted. Shakes shall not show on the faces of either green or seasoned timber.

RESTRICTIONS ON CROSS GRAIN IN BEAMS. Shall not have diagonal grain with slope greater than one in twenty in Volume 1.

(b) RESTRICTIONS ON DENSITY AND RATE OF GROWTH OF SOUTHERN YELLOW PINE.

Adopt the specifications which were adopted during 1915 by the Southern Pine Association and which have been recommended by the Committee on Specifications for Timber of the American Society of Testing Materials, and used in the building code of the National Board of Fire Underwriters. These specifications apply to all southern yellow pine structural timbers where strength is prerequisite.

SOUTHERN YELLOW PINE. This term includes the species of yellow pine growing in the Southern States from Virginia to Texas, that is, the pines hitherto known as longleaf pine *(Pinus palustris)*, shortleaf pine *(Pinus echinata)*, loblolly pine *(Pinus taeda)*, Cuban pine *(Pinus heterophylla)* and pond pine *(Pinus serotina)*.

Under this heading two classse of timber are designated: (A) dense Southern yellow pine and (B) sound Southern yellow pine. It is understood that these two terms are descriptive of quality rather than of botanical species.

Dense Southern yellow pine shall show on either end an average of at least six annual rings per inch and at least one-third summer wood, or else the greater number of the rings shall show at least one-third summer wood, all as measured over the third, fourth, and fifth inches of a radial line from the pith. Wide-ringed material excluded by this rule will be acceptable, provided that the amount of summer wood as above measured shall be at least one-half.

The contrast in color between summer wood and spring wood shall be sharp and the summer wood shall be dark in color, except in pieces having considerably above the minimum requirement for summer wood.

In cases where timbers do not contain the pith, and it is impossible to locate it with any degree of accuracy, the same inspection shall be made over 3 ins. on an approximate radial line beginning at the edge nearest the pith in timbers over 3 ins. in thickness and on the second inch (on the piece) nearest to the pith in timbers 3 ins. or less in thickness.

In dimension material containing the pith but not a 5-in. radial line, which is less than 2x8 ins. in section or less than 8 ins. in width, that does not show over 16 sq. ins. on the cross-section, the inspection shall apply to the second inch from the pith. In larger material that does not show a 5-in. radial line the inspection shall apply to the three inches farthest from the pith.

The radial line chosen shall be representative. In case of disagreement between purchaser and seller the average summer wood and number of rings shall be the average of the two radial lines chosen.

Sound Southern yellow pine shall include pieces of Southern pine without any ring or summer wood requirement.

It is not possible at the present time to recommend similar density and rate of growth specifications for other species.

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(c) SAPWOOD RESTRICTIONS.

Since, for a given species, sapwood of equal moisture content and density, (see explanation in Southern Pine Association's Grading Rules) is as strong as heartwood, sapwood restrictions need only be considered in relation to the efficiency of treatment. With red oaks, hemlocks, and spruces, for reasons brought out under the discussion on ties, no consideration need be given to sapwood restrictions. With the pines and Douglas fir, however, the amount and distribution of sapwood is of much importance. The following classes listed in the order of their suitability for treatment cover restrictions of this nature:

(1). Timbers showing no heart on any face.
(2). Timbers showing no sap on any face.
(3). Heart face timbers with not less than 80% heartwood.
(4). Heart face timbers with not over 20% heartwood.
(5). Other timbers not falling in any of the foregoing classes.

(d) OTHER RESTRICTIONS.

For other restrictions not covered in the foregoing, it is recommended that the specifications of the American Railway Engineering Association, as given on pages 231-234, inclusive, of the 1915 edition of its Manual and reprinted below, be adopted:

STANDARD SPECIFICATIONS FOR SOUTHERN YELLOW PINE BRIDGE AND TRESTLE TIMBER.

(To be applied to single sticks and not to composite members.)

GENERAL REQUIREMENTS.

1. Except as noted, all timber shall be sound, sawed to standard size, full length, square cornered and straight; close grained and free from defects such as injurious ring shakes and cross grain, unsound or loose knots, knots in groups, decay, or other defects that will materially impair its strength.

STANDARD SIZES.

2. "Rough timbers sawed to standard size" means that they shall not be over ¼ in. scant from the actual size specified. For instance, a 12x12 in. timber shall measure not less than 11¾x11¾ inches.

STANDARD DRESSING.

3. "Standard dressing" means that not more than ¼ in. shall be allowed for dressing each surface. For instance, a 12x12 in. timber, after being dressed on four sides, shall measure not less than 11½x 11½ inches.

STANDARD HEART GRADE, LONGLEAF YELLOW PINE.

STRINGERS.

4. Stringers shall show not less than 85% heart on the girth anywhere in the length of the piece; provided, however, that if the maximum amount of sap is shown on either narrow face of the

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stringer, the average depth of sap shall not exceed ⅛ inch. Knots greater than 1½ ins. in diameter will not be permitted at any section within 4 ins. of the edge of the piece, but knots shall in no case exceed 4 ins. in their largest diameter.

CAPS AND SILLS.

5. Caps and Sills shall show not less than 85% heart on each of the four sides, measured across the sides anywhere in the length of the piece, and shall be free from knots over 2½ ins. in diameter.

POSTS.

6. Posts shall show not less than 75% heart on each of the four sides measured across the sides anywhere in the length of the piece, and shall be free from knots over 2½ ins. in diameter.

LONGITUDINAL STRUTS AND GIRTS.

7. Longitudinal Struts and Girts shall be square cornered and sound. One side shall show all heart; the other side shall show not less than 85% heart, measured across the side anywhere in the length of the piece, and shall be free from any large knots or other defects that will materially injure their strength.

LONGITUDINAL X BRACES, SASH AND SWAY BRACES.

8. Longitudinal X Braces, Sash Braces and Sway Braces shall be square cornered and sound; shall show not less than 80% heart on each of two sides, and shall be free from any large knots or other defects that will materially injure their strength.

TIES AND GUARD RAILS.

9. Ties and Guard Rails shall show one side all heart; the other side and two edges shall show not less than 75% heart, measured across the surface anywhere in the length of the piece; shall be free from any large knots or other defects that will materially injure their strength; and where surfaced the remaining rough surface shall show all heart.

STANDARD GRADE, LONGLEAF AND SHORTLEAF YELLOW PINE.

STRINGERS.

10. Stringers shall be square cornered, with the exception of 1 in. wane on one corner or ⅛ in. wane on two corners. Knots shall not exceed in their largest diameter one-fourth of the width of the surface of the stick in which they occur, and shall in no case exceed 4 inches. Ring shakes shall not extend over one-eighth of the length of the piece.

CAPS AND SILLS.

Caps and Sills shall be square cornered, with the exception of 1 in. wane on one corner, or ⅛ in. wane on two corners. Knots shall not exceed in their longest diameter one-quarter the width of the surface of the stick in which they occur, and in no case shall exceed 4 inches. Ring shakes shall not extend over one-eighth of the length of the piece.

POSTS.

Posts shall be square cornered, with the exception of 1 in. wane on one corner, or ⅛ in. wane on two corners. Knots shall not exceed, in their longest diameter, one-fourth of the width of the surface of the stick in which they occur, and shall in no case exceed 4 inches. Ring shakes shall not extend over one-eighth of the length of the piece.

STANDARD SPECIFICATIONS FOR DOUGLAS FIR AND WESTERN HEMLOCK BRIDGE AND TRESTLE TIMBERS.

(To be applied to single sticks and not to composite members.)

STANDARD HEART GRADE.

1. Standard Heart Grade shall include yellow and red Douglas fir and Western hemlock. White Douglas fir will not be accepted.

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GENERAL REQUIREMENTS.

1. All timber shall be live, sound, straight and close grained, cut square cornered, full length, not more than ¼ in. scant in any dimension for rough timber or ½ in. for dressed timber; free from large, loose or unsound knots, knots in groups, or other defects that will materially impair its strength for the purpose for which it is intended, and subject to inspection before loading.

STRINGERS.

3. Stringers shall show not less than 90% heart on each side and edge, measured across the surface anywhere in the length of of the piece. Stringers shall be out of wind and free from shakes, splits, or pitch pockets over ⅜ in. wide or 5 ins. long. Knots greater than 2 ins. in diameter will not be permitted within one-fourth of the depth of the stringer from any corner nor upon the edge of any piece. Knots shall in no case exceed 3 ins. in diameter.

CAPS, SILLS AND POSTS.

4. Caps, Sills and Posts shall show not less than 85% heart on each of the four sides, measured across the surface anywhere in the length of the piece; which shall be out of wind and free from shakes, splits, or pitch pockets over ½ in. wide or 5 ins. long. Knots shall not exceed one-fourth of the width of the surface of the piece in which they occur and shall in no case exceed 3 ins. in diameter.

LONGITUDINAL STRUTS OR GIRTS, X BRACES, SASH AND SWAY BRACES.

5. Longitudinal Struts or Girts, X Braces, Sash and Sway Braces shall show one side all heart. The other side and two edges shall show not less than 85% heart, measured across the surface anywhere in the length of the piece.

TIES AND GUARD TIMBERS.

6. Ties and Guard Timbers shall show one side and one edge all heart. The other side and edge shall show not less than 85% heart, measured across the surface anywhere in the length of the piece.

HOWE TRUSS CHORDS.

7. Timbers for Howe Truss Chords shall show not less than 90% heart on each side and edge, measured anywhere in the length of the piece. They shall be out of wind and free from shakes, splits or pitch pockets over ⅛ in. wide or 3 ins. long. Knots shall not be over 1½ ins. in diameter nor be closer together on each surface than one in any 4 lin. ft.; but if knots are 1 in. or less in diameter, one knot in any 3 lin. ft. will be allowed.

STANDARD GRADE.

8. Standard Grade shall include yellow, red and white Douglas fir and Western hemlock.

GENERAL REQUIREMENTS.

9. All timbers shall be sound and cut square cornered, except that timber 10x10 ins. in size may have a 2-in. wane on one corner or its equivalent on two or more corners. Other sizes may have proportionate defects. Must be free from defects which will impair its utility for temporary work. Knots shall not exceed one-fourth the width of the surface of the piece in which they occur. Timber must be subject to inspection before loading.

STRINGERS, CAPS, SILLS AND POSTS.

10. Stringers, Caps, Sills, and Posts shall be out of wind, free from shakes or splits extending over more than one-eighth of the length of the piece, or knots more than 4 ins. in diameter. Knots greater than 3 ins. in diameter will not be permitted on the edge of any stringer.

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2. Track Ties.

The mechanical properties of timber in relation to the requirements of service conditions and its permeability by the preservative must be considered in selecting species.

The sorting of timbers before treatment is progress in the right direction. It is preferable to treat in each cylinder charge one species of timber.

3. Piles.

The selection and purchase of piles for treatment should take into consideration their ultimate use, whether in salt or fresh water, for land foundation or marine work, and particularly whether subject to marine borers. The sapwood requirements, especially when the heartwood is resistant to treatment, should be based directly on service considerations. The following sapwood restrictions are based on classification of the character of service for which the pile is to be used:

(1). Piles for use in salt water where ravages of marine borers are extremely severe: Specify not less than 2½ ins. of sapwood, nor more than 5 inches.

(2). Piles for use in salt water where ravages of marine borers are less severe than in Group 1: Specify not less than 1 in. sapwood, nor more than 3 inches.

(3). Piles for use in fresh water or foundation work on land: No sapwood restrictions are necessary.

For the present the specifications of the American Railway Engineering Association (1915 Manual, pages 235-236) reprinted below, may be followed as to dimensions and defects of piles:

RAILROAD HEART GRADE.

(1). This grade includes white, burr, and post oak; longleaf pine, Douglas fir, tamarack, Eastern white and red cedar, chestnut, Western cedar, redwood and cypress.

(2). Piles shall be cut from sound trees; shall be close grained and solid, free from defects, such as injurious ring shakes, large and unsound or loose knots, decay or other defects, which may materially impair their strength or durability. In Eastern red or white cedar a small amount of heart rot at the butt, which does not materially injure the strength of the pile, will be allowed.

(3). Piles must be butt cut above the ground swell and have a uniform taper from butt to tip. Short bends will not be allowed. A line drawn from the center of the butt to the center of the tip shall lie within the body of the pile.

(4). Unless otherwise allowed, piles must be cut when sap is down. Piles must be peeled soon after cutting. All knots shall be trimmed close to the body of the pile.

(5). The minimum diameter at the tips of round piles shall be 9 ins. for lengths not exceeding 30 ft.; 8 ins. for lengths over 30 ft. but not exceed 50 ft., and 7 ins. for lengths over 50 feet. The minimum diameter at one-quarter of the length from the butt shall be 12 ins. and the maximum diameter at the butt 20 inches.

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(6). The minimum width of any side of the tip of a square pile shall be 9 ins. for lengths not exceeding 30 ft.; 8 ins. for lengths over 30 ft. but not exceeding 50 ft., and 7 ins. for lengths over 50 feet. The minimum width of any side at one-quarter of the length from the butt shall be 12 inches.

(7). Square piles shall show at least 80% heart on each side at any cross-section of the stick, and all round piles shall show at least 10½ inches diameter of heart at the butt.

RAILROAD FALSEWORK GRADE.

(8). This grade includes red and all other oaks not included in Railroad Heart Grade, sycamore, sweet, black and tupelo gum, maple, elm, hickory, Norway pine or any sound timber that will stand driving.

(9). The requirements for size of tip and butt taper and lateral curvature are the same as for Railroad Heart Grade.

(10). Unless otherwise specified piles need not be peeled.

(11). No limits are specified as to the diameter or proportion of heart.

(12). Piles which meet the requirements of Railroad Heart Grade except the proportion of heart specified will be classed at Railroad Falsework Grade.

C.—Preparation of Timber for Treatment.

1. Air Seasoning.

Adjust the methods of piling ties and lumber for seasoning to the local climate conditions, so as to obtain maximum rapidity in seasoning without undue checking or warping. *Support all piles on treated sill ties, and in all cases at least 6 ins. of air space should be allowed underneath. To allow proper air circulation, the alleys between the piles should extend in continuous lines across the seasoning yard and should be not less than 3 ft. in the working spaces and 1 ft. in other directions.*

In a moist climate and under humid conditions, season all material in open piles, which will provide free circulation of air and exposure to the sun. By open piles is meant the common 1x7, 1x8 or 7x2 piling system, or other arrangement which gives a minimum contact and the maximum of open spaces between the ties. Insist that the stringers be placed as near the end of the ties as possible, then in case of any defects from contact they will not fall upon the rail bearing. In arid climates with low humidity, season in close piles to prevent checking and warping.

Practically all woods can be air seasoned except in low humid locations. Gum is an exception, unless air seasoned under favorable conditions. *Both gum and beech should be seasoned only in wide open piles and watched very carefully for rot.* Bluing of sap pine during seasoning is not necessarily an indication of decay; it should be watched very closely, however, for the brown blotches, which are indications.

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Ties and timbers which have a tendency to check should be protected with "S" irons, or other devices. These should be applied in the seasoning yard to all sticks showing serious initial checks in order to prevent further checking during or after treatment. Red oak and beech should be watched closely in this regard. *All ties should be bored and adzed before treatment,* this insures a uniform bearing surface and maximum penetration at the rail seat. *All timbers should be framed before treatment;* this prevents any exposure of untreated surface where decay would first start.

Oak ties should be given a minimum of eight months seasoning, and should preferably be seasoned 12 months; yellow pine if seasoned in the south, 4 to 6 months; hemlock, tamarack and jack pine 12 months; gum, beech, birch, and hard maple from 4 to 6 months. Winter cut beech is preferable to summer cut; summer cut checks more readily and the sapwood turns dark in seasoning. Over seasoning may prove detrimental with some species.

A determination of whether wood is sufficiently air seasoned for efficient treatment may be based on moisture extraction from borings which should show an average of not over 30% moisture in relation to the oven dry weight of the wood; or, if the above moisture determinations can not be made, season to a constant weight. Consideration may be given to a new Troemroid scalometer device for determining the moisture content of wood. In some cases it is advisable to make local experiments to determine the weight at which timber treats best. (See Bulletin 161, American Railway Engineering Association on "Air Seasoning of Timber.")

All efficient plants should be equipped to steam material which occasion requires, and the best method of introducing and distributing steam in the retort or cylinder is by means of perforated pipes.

Steaming of ties, timber and lumber is apparently not injurious to the wood, if the work is conducted intelligently and within certain limits of temperature and duration.

It is difficult to inject any considerable quantity of preservative into green ties and timbers unless given a preliminary steaming or boiling in oil. One of the principal factors, influencing the absorption of any kind of preservative, is the moisture content of the wood—the drier the wood the more it will absorb, consequently the more thorough the treatment.

The object of steaming is to put the wood in a condition to secure the maximum penetration with the desired amount of preservative, and admits of the immediate treatment of green or fresh cut material.

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Theoretically, steaming of green material preliminary to air seasoning should materially reduce the period of air seasoning.

In steaming, the pressure should at no time exceed 20 lbs. per square inch, nor the oil temperature in boiling exceed 200° F. with possible exceptions in the case of some Pacific Coast timbers which may require higher temperatures.

During the process of steaming a considerable amount of condensed steam remains in the wood, which to some extent resists the entrance of the fluid. The liberating of this condensation, after steaming, may be accomplished by subsequent drying in open air or in drying ovens or by applying a vacuum.

D.—Treatment of Timber.

1. Preservatives.

Coal-tar creosote and zinc chloride are the standard materials used in preserving timber.

2. Processes.

FULL-CELL.

This form of treatment under the name of the Bethell process has been used extensively for years. It is essentially the impregnation of wood with practically all of the creosote it will hold, thereby giving the maximum protection. For many purposes this treatment is too expensive, and, we, therefore, make the following recommendations for its use:

The Committee recommends the use of the full-cell process for piles and other marine timbers where subject to attack of the teredo and other marine borers, and that in such situations an injection of at least 20 lbs. per cubic foot, or treatment to practical refusal, should be given; while in marine and land situations where decay is the principal source of failure, treatments may range down from 20 to 10 lbs. per cubic foot by the same process, the injection in all cases to be sufficient to penetrate all the sapwood.

We further recommend the full-cell treatment in permanent structures not subject to mechanical wear when conditions of moisture, climate or humidity are favorable to wood-destroying fungi, and particularly where the cost of renewals or replacement would be high.

EMPTY-CELL.

Empty-cell treatment with creosote aims to reduce materially the final retention of creosote per cubic foot, giving at the same time depth of penetration.

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The two recognized empty-cell processes base their patent features on fundamentally different means of attaining the same end. One of these requires an initial air pressure which is held during the introduction of the creosote, and the application of the pressure necessary to force it into the wood. When the oil is withdrawn from the treating cylinders and the pressure reduced to sub-normal by a vacuum, the initial air in the wood forces out the surplus creosote. With the other process, a quick high final vacuum is depended upon to recover the surplus oil. By each of these processes a maximum depth of penetration with a final retention of 5 to 8 lbs. of oil per cubic foot is claimed. With some species of wood even smaller quantities of oil may be fully distributed.

With the growing realization that it is entirely useless to preserve timber from decay beyond its mechanical life, empty-cell treatments have rapidly grown in favor and are used by several of the largest railroad systems. While definite deductions may be drawn from theoretical consideration of the two processes and divergent opinions are held, it is not for the Committee to pass judgment, and the fact remains that both processes have received wide recognition.

The essential fact entitling any empty-cell process to recognition, or approval, is that there be an appreciable recovery, usually a minimum of 40% of the oil injected, and that initial penetration before recovery of the surplus be entirely through the treatable portions of the stick; that is, through the sapwood, and at least superficially in the heartwood, the extent of the latter depending on the species. It should be remembered that an average of 5 lbs. per cubic foot may mean a retention of 8 to 10 lbs. per cubic foot in the treatable portions where most needed.

The Committee finds the empty-cell treatment suitable for all pine and other easily treated cross-ties used in moist climates, under service conditions which give a mechanical life in keeping with the anticipated life from decay; also for structures of limited life, or subject to superficial mechanical wear, and elevated so as to be exposed mainly to the wood-destroying influences of weather conditions.

In all outside situations it is recommended that a maximum injection of creosote, or sufficient to insure the penetration of all treatable wood, be required and that not less than an average of 5 lbs. of creosote per cubic foot be left in the treatable portions of the wood; while it is urged as a definitely specified requirement, that at least all of the sapwood and as much of the heartwood as is possible for the particular species shall be thoroughly impregnated, and the depth or extent of the penetration be equal to that of the full-cell treatment.

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To insure uniform bearing surface and maximum penetration under the rail seat, all creosoted ties should be bored and adzed before treatment. Although sawn ties may have a uniform surface, the boring increases the penetration at the point it is most needed.

ZINC CHLORIDE.—*It is recommended where zinc chloride alone is used treatment be by the standard process known as "Burnettising," and that a full impregnation which will insure the retention of a minimum of ½ lb. of dry salt per cubic foot of timber be given.*

We suggest zinc chloride treatment in arid and semi-arid regions, particularly for cross-ties and other material with mechanical life limited to the expectation of life from decay and checking. It should not be used where mechanical wear is eliminated, nor in situations where the treated timber is in permanent or intermittent contact with either stagnant or flowing water. Consideration should also be given to its use on overhead trestles and similar structures.

Under usual conditions three months' seasoning after treatment is advisable.

CREOSOTE-ZINC CHLORIDE.—The use of creosote and zinc chloride in mixture, was started in Germany by Rutgers in 1874. A special creosote was used which remained in mixture with the zinc chloride solution under working conditions.

Rutgers guaranteed that 95% of the ties which he treated by this method would give a minimum of ten years' service in the track. He accepted a penalty if the ties failed in less than ten years, and received a bonus for the life in track in excess of his ten-year-guarantee.

Results obtained from Rutgers process in Germany would indicate a life of ties prepared by the zinc-creosote process, principally pine, of from 12 to 18 years.

The most widely recognized use of this combination in America is a process whereby the creosote and zinc chloride, since they are of different specific gravity, are mixed during treatment by means of a centrifugal pump. A two-movement application of the two preservatives has also been used to a limited extent. In both cases the procedure is based on mechanical methods and not upon process of injection.

This method has been used in America since 1907. Evidence is at hand indicating satisfactory service from timber treated by this process. The records are still incomplete for the reason that the timber is still in service.

Creosote-zinc in mixture is fundamentally effective because composed of the two most widely accepted preservatives. In situations where the mixture is preferable to a single preservative, it should be

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used according to the judgment of the consumer as to its greater economy and efficiency under local conditions.

A. R. JOYCE, *Chairman*
J. B. CARD
O. P. M. GOSS
F. R. MARTIN
GEO. E. REX
LOWRY SMITH
E. A. STERLING
C. P. WINSLOW.

DISCUSSION OF REPORT OF COMMITTEE ON THE PURCHASE AND PRESERVATION OF TREATABLE TIMBER.

By F. S. Pooler.

This report is so interesting I would gladly discuss it a paragraph at a time, but can only hit the high spots in a paper of this length. In these days no one questions the importance and value of wood preservation, and it goes without saying that what is worth doing at all is worth doing well.

It is interesting to observe the evolution of the treating plant during the last few years. More attention is being paid to the proper piling and seasoning of timber; to the proper grading and drainage of the ground it is piled on, and also to the classification of the various kinds of timber to be treated. Many of the yards are now laid out with mathematical precision; all grass, weeds, rubbish, and decaying wood are cleared away and destroyed, and these yards are in a sanitary condition. Does it pay to do this? I believe it pays one hundred cents on the dollar. One of the greatest benefits brought about by this change is the protection of the untreated timber during the seasoning period. A clean tie yard is sure to be a healthy tie yard, and not the least important consideration is its influence on the prospective purchaser of the material. When we go into such a yard we know that the plant is being run on business principles and that someone there takes a pride and interest in doing the work well.

Viewing this subject from the standpoint of the purchaser and consumer suggests further important improvements that may be made. For instance, how many treating plants can tell in what month their timber was cut? Consequently, it is largely a matter of guess work He has an inspector at the plant, but that inspector can only guess at the condition of the timber by general appearance the same as the plant operator does. Occasionally the inspector is able to weigh a charge of timber, and after it has been treated and the weight per cubic foot before and after treatment has been figured out, we can tell whether

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is bright and new, it is piled up, and what recourse has the purchaser? as to how long it has been seasoned. If it looks dry it is treated. If it or not it was a mistake to have it treated at all.

These weighing tests are instructive, and plant superintendents try to be accommodating, but as they increase the cost of operation it is not to be expected they will be regarded with great enthusiasm.

These are the conditions at most treating plants today as far as my experience goes, but you say: "If the purchaser wants to be sure his timber is properly seasoned, why doesn't he buy the timber and pile it up at the plant until he is satisfied it is fit to treat?" But I ask you: "Why should a railroad company, or other purchaser, have to go into the market in competition with the tie-company in order to regulate the seasoning period of its timber?" Why should not the treating plant get this most important matter lined up in a way satisfactory to its customers?

Then comes the question, would the purchaser be willing to pay the additional cost of marking and sorting the ties in order to have the timber in proper condition before treatment? My idea is they should be willing to pay part of this expense. We are always willing to pay what a thing is worth, and do not expect to get it for less.

Much could be done at a small additional expense. Cross-ties intended for treatment could be marked with dating hammers, preferably at the time they are made, or, when this cannot be done, then when they are purchased by the treating companies. These hammers could be made with detachable dies or stamps to be keyed into the face of the hammer—one stamp for each month of the year. The face of the hammer could also bear the permanent brand of the maker or treating-company.

Some sorting is always necessary at a tie plant. Railroads that have treating plants sort all their ties, and figure that it pays them to do so. Unless something of this kind is done, we are simply working in the dark as far as the seasoning period is concerned, and these seasoning specifications do not amount to much. What is the use of specifications unless they are lived up to.

In regard to the use of "S" irons to prevent checking mentioned on the tenth page of the report: These are efficient if made large enough, and applied promptly after the check appears. Our Company makes its own "S" irons. They are made from strips of iron ⅛ in. thick, ¾ in. wide, beveled on one edge, bent into the form of a letter "S" 7 in. in length over all. We used them smaller at first, but found they would not hold.

It would be interesting to have some of the plant operators tell us why more accuracy is not used in determining the seasoning period of treatment timber.

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SEASONING TIMBER.

By R. H. Rawson.

The chief feature of any seasoning method, whether it be natural or artificial, is to reduce the moisture content to such a point that the wood can be easily penetrated with the preservative, at the same time causing a minimum loss in strength.

The steaming process is used with good success at some plants on the Pacific coast, but the writer's experience has been confined to the old boiling process and boiling under vacuum. I will therefore confine this discussion only to the boiling under vacuum. The Committee's report does not cover this method of seasoning, but a very thorough discussion was made at the last meeting of this Association after Mr. Goss's paper was presented. (See PROCEEDINGS for 1916, pages 71 to 84.)

The method of boiling under a vacuum, wherever it has been used on the Coast, has proven successful. The prevailing practice is to use, for lumber and timber, a temperature of about 190° F. with a 26 in. vacuum, while for green piling a temperature of about 210° F. and the same conditions of vacuum are used.

To me the boiling under vacuum process brings up three main points for consideration, namely, (1) the average degrees above boiling, (2) the time and (3) the surface area per cubic foot. The degrees above boiling and the time are factors we can control, so the only variable we have in different retort charges is the surface area per cubic foot.

In order to work out a scheme to determine when the wood is in the proper condition to start pressure, we dry down to what we call a "finishing rate of dryness"; in other words, we figure the amount of condensation that must come off during the last hour of the bath on the basis of a certain percentage of a pound of water per cubic foot of material. We will say, for example, that our experience and experiments have shown us that our finishing rate of dryness should be 0.1 lb. of water per cubic foot per hour for 8x16 timber. Knowing the cubature of the charge under consideration, it is easy to compute the number of inches that must accumulate in the condenser during the last hour of the bath. When this point has been reached the wood is ready for pressure.

The question arises, what is the finishing rate for 2x12 plank under the same conditions of temperture and vacuum? Here the surface area per cubic foot must be considered, and by calculation we find that the 2x12 has 14 sq. ft. per cubic foot, and the 8x16 has 4.5 sq. ft. The correct finishing rate for 2x12 would be:

$$\frac{14}{4.5} \times 0.10 \text{ or } 0.311 \text{ lb. per cubic foot per hour.}$$

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In order to facilitate the comparison of the surface area per cubic foot the writer has prepared curves which show these values for various sized pieces, end area being neglected. In handling material other than Douglas fir, or with different classes of material, when the finishing rate has been worked out for given size piece, under the same conditions of temperature and vacuum, the proper rate for other sizes is easily determined by the use of this set of curves.

The writer has found that due consideration of the surface area, as outlined above, gives very good results in securing dry material, easy penetration and minimum loss of strength. The same consideration should be given in the case of seasoning piles, for it is obvious that the amount of moisture coming off from piles of small diameter will be greater per cubic foot than the amount removed from piles of larger diameters. The reason for this is that small piles have greater surface area per cubic foot than large piles.

THE TIE SUPPLY.

By O. C. Steinmayer.

A. Fundamental Principles.

Statistics as printed in the PROCEEDINGS during the past year show that from 60% to 75% of all material treated in the past was in the form of cross-ties. That part of the recommendation for inclusion in the MANUAL, as follows:

> So far as practical, arrange delivery of material so that the seasoning period may be during seasons of minimum rainfall and humidity.

if followed for cross-ties would prove an undue hardship on the tie producers, and would result in a big increase in the cost of the cross-ties.

By far the greatest production of ties is during the period, November to March, which hardly could be classified in the "seasons of minimum rainfall and humidity" in practically all sections of this country. Further, beech and gum ties, more especially the latter, if cut during the winter months, can be seasoned much more successfully than if cut at any other time of the year.

To me it seems advisable to eliminate that clause and substitute therefor a clause to the effect that all material should be moved to the seasoning yard as soon after cutting as practical.

C. Preparation of Timber for Treatment.

The necessary width of the alley between piles is dependent upon the height to which the material is piled to get the best seasoning conditions and avoid loss through excessive checking because of too rapid seasoning.

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It seems advisable, therefore, that the minimum width of the alley be made 3 ft., which will allow a person to get in between the piles and observe the condition of the end of the timber in the pile during the seasoning period.

THE PRESIDENT: Gentlemen, as you all know, we have the banquet tonight. We will meet tomorrow morning at 10 o'clock.

An adjournment was then taken till January 25.

THURSDAY MORNING SESSION.
January 25.

The meeting was called to order by President Crawford at 10 o'clock A. M.

THE PRESIDENT: We will now have the report of the Committee on Service Tests of Wood-Block Paving. I will ask the Secretary to read the names of this Committee, and they will please take their places on the rostrum.

MR. F. J. ANGIER: Mr. L. B. Moses, Chairman, Mr. R. J. Calder, Mr. Allan W. Dow, Mr. E. G. Draper, Mr. E. R. Dutton, Mr. R. S. Manley, Mr. Phil R. Smith, Mr. J. C. Williams and Mr. Geoffrey Winslow. The report will be presented by Mr. Williams.

REPORT OF COMMITTEE ON SERVICE TEST OF WOOD BLOCK-PAVING.

To the Members of the American Wood-Preservers' Association:

The instructions from the Executive Committee for the guidance of this Committee were as follows:

1. Continue a compilation and tabulation of all data which can be secured on service tests of blocks in streets, bridges and floors indicating in each the kind of wood and method of treatment, and all other data which will be of value.
2. Point out what species of wood, and what character of treatment, service records or data are lacking.
3. Make further recommendations as to how additional data may be effectively procured.
4. Present recommendations for future work to be undertaken by your Committee.

The report of Committee No. 6, presented at the 1916 meeting, included the following paragraphs:

> "The next Committee, however, should not confine their analysis and investigations to the successful pavements alone."

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And the Chairman of this year's Program Committee, in transmitting the instructions quoted above, also stated as follows:

> "You are not restricted to report on satisfactory pavements only, in fact, a study of failures in wood-block pavement should prove profitable, since experience teaches us most when we learn what to avoid."

Through an unfortunate combination of circumstances no work had been done by this Committee up to the middle of October, so at the request of the Chairman of this year's Program Committee the three members from the Atlantic Coast Region have endeavored in the short time remaining to collect data and carry out the various instructions given to the Committee. To accomplish this, circular letters were sent to all cities tabulated in the supplemental report of the Wood-Block Paving Committee for 1915. Up to the writing of the report we have received answers from about half of the cities to which circular letters were sent. This circular letter inquired for special detailed information on three specific streets, namely:

1. The oldest wood-block pavement.
2. The best wood-block pavement, regardless of age.
3. The pavement that has either failed or been most unsatisfactory.

The information requested on these three streets was:

Name of street.
Approximate yardage of the wood-block pavement.
Date when street was paved.
Kind of wood used.
Texture of the wood (rings per inch).
Size of the block used.
Amount of oil injected to the cubic foot of wood and the character of the oil used with analysis, if possible.
Character and depth of foundation.
Kind and depth of cushion used.
Kind, width and number of expansion joints used.
Character of material used for filling joints between the blocks.

Detailed information regarding the treatment of the blocks, including the condition of the wood when treated, the duration and temperature of preliminary heating and steaming, the amount and duration of vacuum, the temperature and amount of oil used and the approximate pressure and length of time in applying the oil, whether the blocks were subjected to further steaming after the treatment or to supplemental vacuum, and, if so, under what conditions.

In addition to these, in inquiring about the street which had failed or was unsatisfactory, we requested information as to what way the street had failed or was unsatisfactory, what in the idea of the engineer caused the failure, and what he would suggest to remedy the defect.

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A compilation of the answers received as to the oldest pavement is given below, arranged chronologically and also classified as to the kind of wood. The first few of the pavements mentioned have not been reported on this year, but our information has been taken from previous reports and from the report of the Wood-Block Paving Committee of 1915.

19 YEARS.—LONGLEAF YELLOW PINE.

Indianapolis, Ind. 60,439 sq. yds. laid in 1898; reported in bad condition, 1914. No report received by this year's Committee.

18 YEARS.—LONGLEAF YELLOW PINE.

Indianapolis, Ind.—7,863 sq. yds. laid in 1899; reported in bad condition, 1914. No report received by this year's Committee.

17 YEARS.—LONGLEAF YELLOW PINE.

Boston, Mass. (Tremont Street).—1295 sq. yds. laid in 1900; still in service and in excellent condition, 1917. Treated with a mixture of rosin and creosote.

Geneva, N. Y. (Lake St.)—Laid in 1900; 4 ins. x 10 ins. x 4 ins. deep, treated with creosote; quantity and type of oil not reported. Six ins. concrete foundation, sand cushion, bituminous-paving joints; no expansion joints. Blocks are said to have been steamed, but no other details of treatment are known. Pavement is still in service, cost of maintenance, not known.

17 YEARS.—FIR.

Spokane, Wash.—1144 sq. yds. laid in 1897; reported replaced in 1914. Blocks were merely dipped in creosote and received very little penetration.

16 YEARS.—LONGLEAF YELLOW PINE.

Indianapolis, Ind.—35,774 sq. yds. laids in 1901.

Boston, Mass.—11,684 sq. yds. laid in 1901.

Youngstown, Ohio.—2,900 sq. yds. laid in 1901. (This is a bridge floor.)

The Indianapolis yardage is in fair condition, and the yardage in the other two cities is still very good.

Springfield, Mass., (Main St. from Lyman St. to Liberty St.)—2780 sq. yds. laid in 1901 4 ins. x 8 ins. x 4 ins. blocks; 21 to 22 lbs. treatment, creosote and rosin mixture. About one-half of this yardage has since been relaid by the city. Wood block wears out under traffic in Springfield in about 10 years. This pavement is on 6 ins. of natural cement concrete, 1 in. sand cushion, sand and pitch-paving joints, pitch in the upper part. No expansion joints. Partly air-seasoned lumber, not steamed. 26 ins. vacuum at 175° to 200° F. Oil pressure, 200 lbs. at 150° F. Final bath of milk of lime.

15 YEARS.—LONGLEAF YELLOW PINE.

Toledo, O.—6,601 sq. yds.

Manhattan, N. Y.—1,152 sq. yds.

Minneapolis, Minn., (10th St. from 1st. Ave. South to Park Ave.).—13,304 sq. yds. laid in 1902. Texture of wood was mixed but fairly good. 4 ins. x 6 ins. to 10 ins. x 4 ins. deep blocks. 12-lb. treatment Kreodone oil. 6 ins. natural cement concrete foundation, 1 in. sand cushion. Pitch-paving joints, 1 in. pitch-expansion joints at curbs. Details of treatment not known. Pavement still in service.

15 YEARS.—FIR.

Seattle, Wash.—1,227 sq. yds., partly replaced.

14 YEARS.—LONGLEAF YELLOW PINE.

Brooklyn, N. Y. (Monroe St., from Nostrand Ave. to Marcy Ave.).—3,262 sq. yds. laid in 1903. 4 ins. x 8 ins. x 4 ins. deep blocks; quantity of oil not known, probably 20 lbs. Oil was 50% creosote and remainder rosin or other suitable waterproofing material. 4½-in. concrete foundation, ½-in. mortar cushion; 1:4. Sand-paving joints. No expansion joints; still in service. Has cost city 10.6 cents per sq. yd. since out of guarantee in 1908.

Chicago, Ill. (Taylor St., Canal to Blue Island Ave.)—7,540 sq. yds. laid in 1903 and 1904, minimum 6 rings. 4 ins. x 6 ins. to 10 ins. x 4 ins. deep blocks; 12-lb. treatment, Kreodone, creosote, paving oil. 6 ins. Portland cement foundation, 1-in. sand cushion. Bituminous cement-paving joints. 1 in. bituminous cement-expansion joints at curbs. ½-in. transverse joints at

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100-ft. intervals. Lumber partly air-seasoned. Blocks were steamed at 200° to 225° F. for 1½ hours; 20-in vacuum at 210° to 145° F. for 1¾ hours. No final steaming or vacuum. About 462 sq. yds. have been repaired up to Nov. 1, 1916.

(Many other cities are know to have had wood blocks in service since 1904. Some of these will be found on pages 337 to 364 of the 1915 Proceedings).

13 YEARS.—LONGLEAF YELLOW PINE.

Borough of Manhattan, N. Y.—Laid in 1904. Cortlandt St., Broadway to West St., 3,387 sq. yds. 7% of surface repaired in 1914 and 1915.

Murray St., Broadway to West St., 6,176 sq. yds. 8% of surface repaired in 1914 and 1915.

20th St., Broadway to 5th Ave., 988 sq. yds. 4% of surface repaved in 1915.

98th St., Central Park West to Amsterdam Ave., 5,521 sq. yds. 1% of surface repaired in 1915.

12 YEARS.—LONGLEAF YELLOW PINE.

Borough of Richmond, N. Y. (Canal St., from Wright St. to Broad St.).—3,471 sq. yds. laid in 1905; heart timber. 3 ins. x 8 ins. x 4 ins. blocks. Treated to weigh 62½ (plus) lbs. per cu. ft. Oil analysis not reported. 6 ins. concrete foundation, 1 in. sand cushion. Sand-paving joints; 1 in. bituminous-paving joints at curbs. No details of treatment or oil available. No maintenance expense to Nov. 1, 1916.

Borough of Queens, N. Y. (Metropolitan Ave., from Borough line to Helen St.)—12,165 sq. yds. laid in 1905, all heart. 3 ins. x 8 ins. x 3½ ins. deep blocks. Quantity of oil not reported, probably 20 lbs. per cu. ft. Oil was 50% creosote and 50% rosin. 6 ins. concrete foundation, 1½ ins. cement mortar cushion. Sand-paving joints. No record of condition of lumber. Blocks were subjected to dry heat up to 215° F. for one hour, heat was then increased to 285° F. No other details of treatment reported. No record of maintenance expense kept.

Detroit, Mich. (Catherine St., from Chene St. to Jos. Campau St.).—2,062 sq. yds. laid in 1905. Minimum 7 rings per inch. 3 ins. to 4 ins. x 6 ins. to 10 ins. x 3½ ins. deep blocks. 16-lb. or 20-lb. treatment. No oil analysis reported. 6 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. 1½ ins. tar-expansion joints at curbs. No report of details of treatment. No report of cost of maintenance.

Borough of Manhattan, N. Y. (Duane St., Broadway to West St.).—7,648 sq. yds. laid in 1905. 6% of repairs in 1913, 1914 and 1915.

East Broadway, Chatham Square to Grand St., 19,379 sq. yds. 6% of repairs in 1913, 1914 and 1915.

Hudson St., Jay St. to Worth St., 1060 sq. yds. 4% of repairs in 1913 and 1914.

Jefferson St., Henry St. to East Broadway, 627 sq. yds. No repairs up to 1915.

John St., Nassau to Broadway, 888 sq. yds. No repairs up to 1915.

Liberty St., Broadway to West St., 3,040 sq. yds. 3% repairs in 1913 and 1914.

(List of other cities having 12-year old pavements will be found in the 1915 Proceedings.)

11 YEARS.—LONGLEAF YELLOW PINE.

Kansas City, Mo. (Admiral Boulevard from Grand Ave. to Cherry St.).—6,860 sq. yds. laid in 1906. 4 ins. x 5 ins. to 10 ins. x 3½ ins. deep blocks. 16-lb. treatment creosote of specific gravity 1.09. Oil analysis not reported. 5 ins.-1.3.7 Portland cement foundation. 1 in. sand cushion. Sand-paving joints. 1 in. tar-expansion joints at curbs. Transverse joints every 200 ft. No details of treatment reported. No maintenance expense reported.

The following streets in the Borough of Manhattan, N. Y., laid in 1906 with longleaf yellow pine blocks, have required but a small percentage of repairs:

Barclay St., Broadway to West St., 5,272 sq. yds. 4% of surface repaired up to 1915.

Beekman St., Nassau St. to Park Row, 650 sq. yds. No repairs up to 1915.

Old Slip, Front St. to Water St., 1,356 sq. yds. No repairs up to 1915.

Park Place, Broadway to West St., 6,499 sq. yds. 2% of surface repaired in 1915.

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West Broadway, Dey St. to 4th St., 28,746 sq. yds. 8% of surface repaired in 1913, 1914 and 1915.

Worth St., Broadway to Church St., 1,644 sq. yds. No repairs up to 1915.

10th St., Hudson to West St., 2,525 sq. yds. No repairs up to 1915.

(List of other cities having wood-block pavements 11 years old will be found in the 1915 Proceedings.)

11 YEARS.—TAMARACK.

Austin, Minn, (Bridge St., from Main St. to St. Paul St.).—1,173 sq. yds. laid in 1906. 3½ ins. deep blocks. 16-lb. treatment. No report of type of oil. 5 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. ¾ in. pitch-expansion joints at curbs. No details of treatment reported. Has cost $2.50 maintenance to Nov. 1, 1916.

10 YEARS.—LONGLEAF YELLOW PINE.

Bridgeport, Conn. (Fairfield Ave., from Park Ave. to Clinton Ave.).—13,700 sq. yds. laid in 1907. Texture of wood, minimum 5 rings per inch. 3 ins. x 5 ins. to 8 ins. x 3½ ins. deep blocks. Treatment and type of oil not reported. 6 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. 1 in. pitch-expansion joints at curbs. ½ in. transverse joints every 75 ft. No details of treatment reported. No record kept of cost of maintenance.

Borough of Manhattan, N. Y.—Two streets were paved with wood blocks in 1907: Bowling Green from Whitehall to State St., 1,134 sq. yds., and Bridge St., from Whitehall to State St., 744 sq. yds. No repairs were made on either of these streets up to 1915.

(List of other cities having wood-block pavements 10 years old will be found in the 1915 Proceedings.)

9 YEARS.—LONGLEAF YELLOW PINE.

New Haven, Conn. (State St., from Grand St. to Chapel St., also Court St., Center St., Meadow St., from Congress St. to Water St., Church St., from George St. to Chapel St.)—Total 17,000 sq. yds. laid in 1908. 3 ins. x 8 ins. x 3 ins. deep block, 90% heartwood, 20-lb. treatment, rosin and creosote mixture, at least 75% creosote.

Oil Analysis:

Specific gravity at 68° F.	1.12
Loss on distillation up to 315°C.	22.53%
Total loss on distillation up to 350°C.	27.53%
Suspended matter insoluble in benzol	2.50%

Oil conformed to the specification requirements. 6 ins. 1.3.6 Portland cement concrete foundation. Mortar cushion (sand has since been used.) Sand-paving joints. ½ in. bituminous-expansion joints at curbs. Transverse joints were originally put in at 100 ft. intervals. These not appearing to be necessary were later removed, and the space filled by relaying two or three courses with wider blocks. Blocks were subjected to live steam for 3 hours at an average temperature of 220°F. Vacuum, 24 ins. for an average of 2 hours. Oil injected at average maximum temperature of 170°F. Pressure maintained for an average of 4½ hours. Average maximum pressure, 200 lbs. Very little maintenance expense on these streets, and that merely next to street-car tracks, especially at street intersections.

Philadelphia, Pa. (Market St., from 2nd St. to 23rd St.).—80,000 sq. yds. laid in 1908 and 1909. 4 ins. x 8 ins. x 4 ins. deep blocks, 90% heartwood, minimum 20-lb. treatment specified, rosin and creosote mixture: 75% oil, 25% rosin. Inspector's report shows 22 to 25 lbs. of oil were injected.

Oil Specification:

Minimum specific gravity at 25°C.	1.10
Pure coal-tar product, free from oil-tar or water-gas tar products.	
Maximum insoluble in benzol	5%

Distillation:

Maximum up to 150°C.	none
" " " 210°C.	10%
" " " 235°C.	20%
" " " 315°C.	35%
" " " 370°C.	50%

5½ ins. concrete foundation, ½ in. mortar cushion. Cement-grout paving joints. ¾ ins. to 1 in. expansion joints along the curbs. Details of treatment: Blocks were subjected to live steam 5 hours at temperature 240 to 260°F.;

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vacuum, 13 ins. to 25 ins. for ½ hour. Oil injected at average maximum temperature of 212°F. Oil pressure maintained 3 to 7 hours; average maximum pressure, 175 lbs.

Pittsburgh, Pa. (Cecil Place, from Liberty St. to Penn. Ave.).—374 sq. yds. laid in 1908. 4 ins. x 6 ins. to 10 ins. x 3½ ins. deep blocks. 20-lb. treatment, rosin and creosote mixture, 75% or less oil and 25% rosin. Oil analysis not reported. 6 ins. concrete foundation. ½ in. 1:4 mortar cushion. Air-seasoned lumber. No details of treatment reported.

WHITE PINE, NORWAY PINE AND TAMARACK.

Grand Forks, North Dakota, (3rd St., from Belmont to Ione St.).—3¼ ins. deep blocks, 20-lb. treatment.

Oil Analysis:

Specific gravity at 20°C	1.119

Distillation:

Up to 150°C	none
" " 170°C	0.5%
" " 210°C	3.2%
" " 235°C	16.8%
" " 315°C	43.9%
" " 355°C	55.4%

6 ins.—1.3.6 concrete foundation, screened gravel aggregate. 1½ ins. sand cushion. Tar-paving joints. Tar-expansion joints at curbs. Transverse joints every 100 ft. No preliminary steaming of blocks. 22 ins. vacuum for 1½ hours. Oil pressure maintained for 4¼ hours. Maximum pressure, 160 lbs. Temperature of oil, 205°F. maximum. The maintenance expense on this pavement has been practically nothing, except along the street-car rails.

8 YEARS.—TAMARACK AND NORWAY PINE.

Albert Lea, Minn. (Broadway, from Water St. to Pearl St.).—10,300 sq. yds. laid in 1909. 4 ins. x 4 ins. to 9 ins. x 3 ins. deep blocks. 16-lb. treatment. No record of oil analysis. 5 ins concrete foundation. 1 in. sand cushion. Bituminous-paving joints. 1½ ins. bituminous-expansion joint at the curbs. No details of treatment on record. No exact record of maintenance. There has been some slight expense for repairs on account of heaving.

7 YEARS.

Clinton, Iowa (3rd St., from 3rd Ave. to 4th Ave., and 3rd Ave., from 3rd St. to 4th St.).—4,570 sq. yds. of 3-in. deep wood block laid in 1910. 20-lb. treatment. The kind of wood is not stated. Blocks are laid on 5 ins. of concrete with 1-in. sand cushion and asphalt-paving joints. 2 ins. asphalt-expansion joints at the curbs. No details of treatment reported.

7 YEARS.—LONGLEAF YELLOW PINE.

East St. Louis, Ill. (Vogel Place, from State St. to College Ave.)—4,700 sq. yds. laid in 1910. 3¾ ins. x 6 ins. to 10 ins. x 3 ins. deep blocks, 6 rings per inch. Specific gravity of oil specified, 1.10 minimum. 5 ins. concrete foundation. 1 in. sand cushion. Coal-tar pitch-paving joints. 1 in. coal-tar pitch-expansion joints at the curbs. No details of treatment at hand. Cost of maintenance not reported.

7 YEARS.—TAMARACK.

Faribault, Minn. (Central Ave., Division St. intersection).—528 sq. yds. laid in 1910. 4 ins. x 5 ins. to 8 ins. x 3 ins. deep blocks. 16-lb. treatment. No oil analysis reported. 5 ins. concrete foundation. 1 in. sand cushion. Tar-paving joints. 1 in. tar-expansion joints at the curbs. No details of treatment reported. Maintenance has been nil.

6 YEARS.—LONGLEAF YELLOW PINE.

Watertown, N. Y. (High St., from State St. to Factory St.).—6,000 sq. yds. laid in 1911. 3 ins. deep blocks. Texture not reported. 20-lb. treatment. Oil analysis not reported. 5 ins. concrete foundation, ½ in. sand cushion. Sand-paving joints. Paving pitch-expansion joints at curbs. No report of condition of lumber, or details of treatment.

Memphis, Tenn. (Madison St., from Front St. to Poiningo St.).—10,117 sq. yds. laid in 1911. 4 ins. x 5 ins. to 10 ins. (average 8 ins.) x 3½ ins. deep blocks. Minimum, 6 rings per inch. Coal-tar oil, minimum gravity, 1.10 at 38°C. 6 ins. concrete foundation. 1 in. to 2 ins. sand cushion. Pitch-paving joints. 2 ins. pitch-expansion joints at curbs. ½ in. pitch-transverse joints, every 50 ft. Lumber was green, and blocks were steamed before treatment. No other details of treatment reported.

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Wichita Falls, Tex. (7th St., from Ohio St. to Alley West of India St.)—Laid in 1911. 4 ins. x 8 ins. x 3 ins. deep blocks—Minimum 6 rings per inch. 20-lb. treatment. Oil analysis not reported. 5 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. 1 in. Asphalt-expansion joints at curbs. Asphalt-transverse joints every 25 ft. No details of treatment. No record of maintenance expense.

Cedar Rapids, Iowa. (16th Ave. Bridge, from 1st St. East to A St. West.).—3,000 sq. yds. laid in 1911. 4 ins. x 5 ins. to 10 ins. x 3 ins. deep blocks. 6 rings per inch. 16-lb. treatment with coal-tar creosote. 5 ins. concrete foundation. ¾ ins. cement mortar cushion. Bituminous-paving joints. 1 in. bituminous-expansion joints at curbs. No details of treatment reported. No expense for maintenance up to Nov. 1, 1916.

6 YEARS.—NORWAY PINE AND TAMARACK.

Rochester, Minn. (Broadway, from College St. to Ninth St.).—22,000 sq. yds. laid in 1911. 4 ins. x 5 ins. to 10 ins. x 3½ ins. deep blocks. 6 rings per inch. 16-lb. treatment with coal-tar product. 5 ins. concrete foundation. 1 in. sand cushion. Bituminous-paving joints. 1 in. paving pitch-expansion joints at curbs. No details of treatment reported. Cost of maintenance has not been anything.

5 YEARS.—LONGLEAF YELLOW PINE.

Petersburg, Va. (East Bank St., from Sycamore St. to Second St., and Second St., from East Bank St. to Bolling Brook St.).—2,200 sq. yds. laid in 1912. 3½ ins. deep blocks. Minimum 4 rings, average 8 rings per inch. 16 to 18-lb. treatment with coal-tar creosote of specific gravity 1.03 to 1.14 at 38°C. 4 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. 1 in. clay-expansion joints at curbs. No details of treatment reported. Cost $25.00 for maintenance up to Nov. 1, 1916.

Fort Smith, Ark. (Garrison Ave., from First St. to 13th St.).—35,000 sq. yds. laid in 1912. 3½ ins. deep blocks. Minimum 6 rings per inch. 16-lb. treatment. Oil analysis not reported. 8 ins. concrete foundation. 1 in. sand cushion. Bituminous-paving joints. ½ in. bituminous-expansion joints every 50 ft. transversely. No details of treatment reported. Up to Nov. 1, 1916, $125.00 has been spent for maintenance on account of bulging.

St. Paul, Minn. (5th St., from Wabash to St. Peter, and from Cedar to Jackson.)—4,213 sq. yds. laid in 1912. 4 ins. x 5 ins. to 10 ins. x 4 ins. deep blocks. Average not less than 6 rings per inch. 16-lb. treatment with tar creosote. 5 ins. Portland cement, concrete foundation, 1 in. sand cushion. Bituminous-paving joints. 1½ ins. pitch-expansion joints at curbs. No details of treatment reported. Cost nothing for maintenance up to Nov. 1, 1916.

Providence, R. I. (Exchange St., from Westminister St. to Exchange Place).—550 sq. yds. laid in 1912. 4 ins. x 8¼ ins. x 3½ ins. deep blocks. Texture of wood and quantity of oil not reported. 6 ins. or over cement-concrete foundation. 1 in. sand cushion. Sand-paving joints. 1 in. specification "B" pitch-expansion joints at curbs. No details of treatment reported. Cost nothing for maintenance up to Nov. 1, 1916.

WOOD-BLOCK PAVEMENTS REPORTED BY DIFFERENT CITIES AS BEING THE BEST AND MOST SATISFACTORY UP TO JANUARY 1, 1917.

LONGLEAF YELLOW PINE.

Paved In 1910.

New Haven, Conn. (State St., from Chapel St. to Water St.).—This street is typical, others are practically as good. 5,125 sq. yds. Minimum, 6 rings. 3 ins. x 8 ins. x 3½ ins. deep blocks. 20-lb. treatment with coal tar-paving oil. Analysis as follows:

Specific gravity at 38°C	1.168
Insoluble in benzol	2.5 %
Water	1.0 %

Distillation:

Up to 150°C	0.6%
150 to 255°C	13.9%
255 to 305°C	9.9%
305 to 315°C	1.8%
Total to 315°C	26.2%

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Specific gravity of fraction 255° to 315°C.....1.049
Unsulphonated residue fraction 305° to 320°C.....Trace

Distillates were all solid at 60°F., and the oil conformed to the specifications of the City of New Haven.

6 ins. 1.3.5 Portland cement concrete foundation. Sand cushion and sand-paving joints were used. ¾ in. bituminous expansion-joints at curbs, and ½ in. transverse joints made up in three joints at 100 ft. intervals. Blocks were subjected to dry heat at average temperature of 170°F., then live steam at 240°F. for an average of 3½ hours. Vacuum 24 ins. for an average of 1½ hours. Oil injected at an average maximum temperature of 180°F. Oil pressure maintained 2½ hours average time at 160 lbs. average maximum pressure. No final steaming or vacuum. No expense for maintenance up to Nov. 1, 1916.

Paved In 1911.

Chicago, Ill. (California Ave., West Division St. to West North Ave. and others).—10,040 sq. yds. Minimum, 6 rings. 3¾ ins. x 5 ins. to 10 ins. x 4 ins. deep blocks. 16-lb. treatment. 6 ins. Portland cement-concrete foundation. 1 in. torpedo sand cushion. Sand-paving joints. 1 in. coal tar-paving pitch expansion joints at curbs. ¼ in. transverse pitch joints every 25 ft. Partly air-seasoned lumber. Steamed 1¾ hours at 215° to 225°F. Vacuum 20 ins. for 2 hours at 220°F. down to 150°F. No final steaming or vacuum. No expense for maintenance reported up to Nov. 1, 1916.

Minneapolis, Minn. (Park Ave., 28th to 34th Sts.).—15,135 sq. yds. 6 rings per inch. 4 ins. x 6 ins. to 10 ins. x 3½ ins. deep blocks. 16-lb. treatment with tar oil.

Oil Analysis:

Specific gravity at 38-15°C	1.106
Water	2.1 %

Distillation:

Up to 150°C	0.5 %
" " 170°C	0.9 %
" " 210°C	3.37%
" " 235°C	13.89%
" " 315°C	48.51%
" " 355°C	55.36%

5 ins. concrete foundation, 1 in. sand cushion. Bituminous-paving joints. 1 in. pitch-expansion joints at curbs. Partly air-seasoned lumber. Steamed 60 to 90 minutes. Vacuum, 26 ins. for 90 minutes, at 210°F. Final steaming when necessary to clean the blocks. No expense for maintenance up to Nov. 1, 1915.

Delaware, O. (Central St., Elizabeth St. to Campbell St.).—3,700 sq. yds. 90% heart. 3 ins. x 6 ins. to 8½ ins. x 3 ins. deep blocks. 16-lb. treatment.

Oil Analysis:

Specific gravity at 38°C	1.126
Water	2 %
Insoluble matter	2.08 %
Total distillate up to 315°C	34.5 %

6 ins. 1.3.6 concrete foundation. 1 in. sand cushion. Bituminous-paving joints. 1 in. tar-expansion joints at curbs. 1 in. transverse tar joints at 50-ft. intervals. Dry heat in cylinders. No expense for maintenance up to Nov. 1, 1916.

Paved in 1912.

Cambridge, Mass. (Massachusetts Ave., Lafayette Square to Central Square and Quincy Square to Dunater St.)—26548 sq. yds. longleaf yellow pine. Average 8 rings per inch. 50% heartwood, 3 ins. x 8 ins. x 4 ins. deep blocks, and 3 ins. x 8 ins. x 3½ ins. deep blocks, 20-lb treatment, refined water-gas tar.

Oil Analysis.

Specified gravity at 38°C	1.128
Insoluble in C. S_2	0.60

Distillation:

Below 170°C	0.50%
170—205°C	0.50%
205—235°C	1.70%
235—255°C	4.10%
255—270°C	5.80%
270—315°C	15.00%
315—370°C	24.60%
Residue	47.80%

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Condition of residue, hard.

Insoluble in dimethyl sulphate	none
Specific gravity of distillate, 255° to 315°C at 60°C	1.00

5 ins. concrete foundation, 1 in dry mortar cushion. Cement grout-paving joints. ½ in. Genasco asphalt-expansion joints at curbs. ½ in transverse joints of same material every 30 ft. Partly air-seasoned lumber. Steamed for 2 hours at 220° to 240° F. Vacuum, 20 ins. for 2 hours at 240° to 150° F. No final steaming or vacuum was applied. No expense for maintenance up to Nov. 1, 1916.

Pittsburgh, Pa. (East Ohio St., Federal St. to Chestnut St.)—6000 sq. yds. longleaf yellow pine, average 8 rings per inch. 3 ins. x 8 ins. to 10 ins. x 3½ ins. deep blocks—22-lb. treatment. 6 ins. concrete foundation. ½ in. mortar cushion. Bituminous-paving joints. 1 in. expansion joints at curbs. No expense for maintenance up to Nov. 1, 1916.

Memphis, Tenn. (Mulberry St., Beale to Calhoun Sts.)—9908 sq. yds. longleaf yellow pine, minimum 6 rings per inch. 4 ins. x 5 ins. to 10 ins. x 3½ ins. deep blocks. 16-lbs. coal-tar oil. 6 ins. concrete foundation, 1½ ins. sand cushion. Bituminous-paving joints. 2 ins. pitch-expansion joints along curbs. Blocks were not steamed. No final vacuum; other details of treatment not reported. No expense for maintenance up to Nov. 1, 1916.

Borough of Richmond, N. Y. (Richmond Terrace, Nicholas St. to Stuyvesant Place.)—1458 sq. yds. longleaf yellow pine. 3 ins. x 8 ins. x 4 ins. deep blocks. 20-lb.treatment.

Oil analysis.

	Sample No. 1.	Sample No. 2
Specified gravity at 38°C	1.087	1.059
Napthalene (crystallizable)	23.5%	over 40%
Phenol acids	8.8%	7.9%

8 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. 1 in. bituminous-expansion joints at curb. Condition of lumber and details of treatment not reported. No maintenance expense up to Nov. 1, 1916.

Borough of Queens, N. Y. (Jackson Ave., from Borden Ave. to Thompson Ave.)—19070 sq. yds. longleaf yellow pine, standard 1905 rules. 3 ins. x 8 ins. x 3½ ins. deep blocks, 20-lb. treatment. Oil analysis not reported. 8 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. ⅛ in. paving pitch-expansion joints at curbs, along trolley tracks, and transversely every 200 ft. Condition of lumber and details of treatment not reported. No maintenance expense up to Nov. 1, 1916.

Paved in 1913.

Bridgeport, Conn. (Stratford Ave., Connecticut Ave. to City Line.)—29,500 sq. yds. longleaf yellow pine. Average 8 rings; minimum 5. 3 ins. x 5 ins. to 8 ins. x 3½ ins. deep blocks. 16-lb. treatment.

Oil Analysis.

Specific gravity	1.121
Free carbon	2.2%

Distillation:

Up to 150°C	0.5%
" " 315°C	37.0%

Refined coal-tar and creosote.

8 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints, ¾ in. asphalt felt expansion joints at the curbs. ½ in. transverse joints same material every 75 ft.

Lumber was air-dried to 40 lbs. per cubic foot. Blocks steamed before treatment. Temperature 240° to 244° F. for 2 or 3 hours. Vacuum then applied 23 to 25 in. No final steam or vacuum. No maintenance expense up to Nov. 1, 1916.

Providence, R. I. (Brook St., Benevolent St. to Lloyd Ave.)—8,289 sq. yds. longleaf yellow pine with minimum of 6 rings per inch. Blocks 3 ins. x 8 ins. x 3½ ins. deep. 18 to 21-lb. oil treatment. Oil used, coke oven tar and creosote mixture.

Oil Analysis.

Specific gravity at 38°C	1.133

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Distillation.

Up to 255°	19 %
255°C to 315°C	16 %
Specific gravity of fraction 255° to 315°C. @ 60°C	1.031

No expense for maintenance up to Nov. 1, 1916.

Charleston, S. C. (Hasell St., King St. to Meeting St.)—1900 sq. yds. long leaf yellow pine. Average 6 rings per inch. 3 ins. x 8 ins. x 3 ins. deep blocks 16-lb. treatment.

Oil Analysis.

Specific gravity at 38°C	1.1037
Free carbon	3.5 %

Distillation:

Up to 150°C	0.3 %
Up to 315°C	37.8 %

4 ins.—1.3.6 concrete foundation. 1 ins. sand cushion.

Sand paving joints. 1 in. bituminous-expansion joints at curb. Lumber mixed some green, some dry and some wet from rain, treated separately. Weight untreated 44½ to 45 lbs. per cubic foot. Steamed 3 hours at 240°F., then 22 ins. to 26 ins. vacuum for 3 hours. Oil injected at 110 to 140 lbs. pressure at 160° to 180°F. No supplementary steaming or vacuum. Average weight per cubic foot treated, 61 to 62 lbs.

Maintenance expense very little, if any, up to Nov. 1, 1916.

Wichita Falls, Tex. (Ohio St., 10th to 11th Sts.)—3,000 sq. yds. long leaf yellow pine. Minimum 6 rings. 4 ins. x 8 ins. x 3 ins. deep blocks. 16-lb. treatment. Oil analysis not reported. 5 ins. concrete foundation. 1 in. sand cushion. Bituminous paving joints. 1 in. asphalt-expansion joints at curb and every 25 ft. transversely. Details of treatment not reported. No expense for maintenance up to Nov. 1, 1916.

Paved in 1914.

Petersburg, Va., (Perry St., Washington St. to Lawrence St.)—1200 sq. yds. yellow pine, minimum 4 rings; average 8. 3 ins. to 4 ins. x 5 ins. to 10 ins. x 3½ in. deep blocks. 16-to 18-lb. treatment. Creosote, 1.03 to 1.14 gravity at 38°C. Analysis not reported. 4 in. concrete foundation. 1 in. sand cushion. Sand-paving joints. 1 in. Clay-expansion joints at curb. Details of treatment not reported. No expense for maintenance up to Nov. 1, 1916.

San Antonio, Tex. (West Commerce St., Alamo St. to Soledad St.)—4700 sq. yds. outside of traction area. Longleaf yellow pine. Average 8 rings; minimum 5. Average 80% heart; minimum 50%. 3 in. x 6 in. to 8 ins. x 3½ in. deep blocks. 16-lb. treatment. No oil analysis reported. Pure coal tar distillate specified, to comply with the following requirements:

> Free from all adulteration and containing no raw tar, filtered or unfiltered tars or pitches, petroleum compounds, or other tar products.
>
> Specified gravity at 38°C.....1.03 to 1.08
> Maximum, insoluble in benzol and chloroform..... 2 %

Distillation.

At 210°C	5% Max.
" 235°C	25% "
" 315°C	86% "
Maximum coke residue	3%
Maximum water	3%

Distillates 210°-235° C. shall yield solids on cooling to 15° C. 5 ins. reinforced 1.3.6 concrete foundation. ½ in.-1: 3 mortar cushion. Asphalt cement paving joints. 1½ in. expansion joints at the curbs. Details of treatment not reported or specified. No expense for maintenance reported to Nov. 1, 1916.

Paved in 1915.

Kansas City, Mo. (Walnut St., 7th to 12th St.)—6500 sq. yds longleaf yellow pine. Minimum 8 rings. 3⅞ ins. x 5 ins. to 10 ins. x 3½ ins. deep blocks. 16-lb. treatment.

Oil Analysis.

Specific gravity	1.12

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Distillation:

Up to 100°C	none
" " 150°C	1.10%
" " 225°C	12.98%
" " 315°C	37.77%

8 ins. concrete foundation 1.3.6. Portland Cement. ½ in.-1 to 4 mortar cushion. Asphalt cement-paving joints. 1½ ins. expansion joints, same material at curbs only. Partly air-seasoned lumber, steamed under 10 to 20 lbs. pressure for 2 to 4 hours. Vacuum, 24 ins. for 2 hours at 240° to 160°F. No final steaming. 24 ins. final vacuum for one hour at 190° to 125°F. No maintenance expense up to Nov. 1, 1916.

Brooklyn, N. Y., (Rockwell Place, Fulton St. to Lafayette Ave.)—This street is merely typical as many wood-block pavements in Brooklyn are identical in service. 1215 sq. yds. longleaf yellow pine. 7 rings per inch. 3 ins. x 8 ins. x 4 ins. blocks. 20-lb treatment.

Oil Analysis.

Specific gravity to 38°C	1.133

Distillation:

Water	none
170°-200°C.	none
200°-210°C.	1.00%
210°-235°C.	4.10%
235°-255°C	9.70%
255°-315°C.	22.40%
Total to 315°C	37.20%
Specific gravity of fraction 255°-315°C, at 60°C	1.04

4½ ins. Concrete foundation, Portland cement. ½ in. mortar cushion, 1 part cement to 2½ parts sand. Bituminous-paving joints. ¾ in. expansion joints at curbs. Filler for these joints was a mixture of coal-tar pitch and refined asphalt. Thoroughly air-seasoned lumber steamed at 150°F. for 4 to 4½ hours. Vacuum 24 ins. for 2½ to 3 hours. Temperature not stated. No record of final steaming or vacuum. No expense for maintenance up to Nov. 1, 1916.

Philadelphia, Pa. (Chestnut St., 12th St. to 15th St.)—3325 sq. yds. longleaf yellow pine. Average 7 rings; minimum 5. 4 ins. x 8 ins. x 4 in. blocks. 18-lb. treatment.

Oil Analysis.

Specific gravity @ 38°C	1.1002

Distillation:

Up to 150°C	2.15%
" " 315°C.	31.65%
Insoluble in benzol	2.99%

6 ins. concrete foundation. 1 in. mortar cushion, 1 part cement to 4 parts sand. Sand-paving joints. 2½ ins. bituminous-expansion joints, 1 in. at each curb and ¼ in. on outside of both rails. Green and partly air-seasoned lumber. Steamed at 225° to 240°F. for 4 hours. Vaccum, 23 ins. for 1½ hours. Temperature not stated. No final steaming or vacuum. No expense for maintenance up to Nov. 1, 1916.

Paved in 1916.

East St. Louis, Ill. (Broadway from 3rd St. to St. Clair County Turn-Pike.)—4700 sq. yds. longleaf yellow pine. Minimum 5 rings, average 7. 3 ins. and 4 ins. x 5 ins. to 8 ins. x 3½ ins. deep blocks. 16-lb. treatment. No oil analysis reported. A product of coal-gas tar, specific gravity 1.07 minimum to 1.11 maximum at 38°C. was specified. 7 ins. concrete foundation, ⅝ in. mortar cushion. Bituminous-paving joints. 1 in. combination asphalt and fiber-expansion joints at curbs. Partly air-seasoned lumber. Some blocks were steamed for 5 hours at 236°F. Vacuum, 24 ins. for 2 hours. Temperature not reported. No final steaming or vacuum. No maintenance expense reported up to Nov. 1, 1916.

Dayton, Ohio. (Grand St., from Salem St. to Grafton Ave.)—4200 sq. yds. longleaf yellow pine. 6 rings per inch. 4 ins. x 5 ins. to 10 ins. x 3½ in. blocks. 20-lb. treatment. No oil analysis reported; 1.08 to 1.14 gravity. Tar oil specified, but no analysis given. 6 ins. 1.3.6. concrete foundation. ½ in. 1.4 mortar cushion. Asphalt paving joints, ¾ in. asphalt-expansion joints at curbs. Blocks steamed at 220°F., time not stated. Vacuum, 20 ins. at 170° to 200°F., time not stated. Final steaming temperature and time not stated. No final vacuum. New pavement, no maintenance expense up to Nov. 1, 1916.

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TAMARACK AND NORWAY PINE.

Paved in 1913-1914-1915.

Austin, Minn. (Kenwood Ave., South Main St., Lansing Ave., Bridge St., Maple St. and Greenwich St.)—60,000 sq. yds. 5 ins. to 10 ins. x 3 in. deep blocks. 16-lb. treatment. Oil analysis not reported. 6 in. concrete foundation. 1 in. sand cushion. Pitch-paving joints. 1¼ in. asphalt-expansion joints at curbs. No record of details of treatment. No maintenance expense up to Nov. 1, 1916.

Paved in 1913.

Duluth, Minn. (1st St., 2nd Ave. East to 6th Ave. East.)—8700 sq. yds. tamarack. 8 rings per inch. 5 ins. to 10 ins. x 3½ in. deep blocks. 16-lb. treatment. Society for Standardizing Paving 1912 specifications for oil which permitted alternatively a coal tar distillate or a coal tar-paving oil. No report as to which type of oil was used. Concrete foundation. ½ in. to 1 in. sand cushion. Bituminous-expansion joints at curbs. Block laid at an angle of 22½° with a line at right angles to the center line of the street. No record of details of treatment available. No report received of maintenance expense.

Billings, Mont. (1st Ave. South or District 87.)—29000 sq. yds. western tamarack, texture not stated. 4 ins. x 5 ins. to 10 ins. x 3 in. deep blocks. 16-lb. treatment.

Oil Analysis.

Specific gravity at 38°C	1.115
Insoluble in benzol and chloroform	2.49 %

Distillation.

Up to 150°C	0.10 %
150 to 170°C	0.70 %
170 to 210°C	4.13 %
210 to 235°C	6.53 %
235 to 355°C	43.79 %
Residue	42.56 %
Loss	2.19 %

5 ins. concrete foundation. 1 in. sand cushion. Bituminous-paving joints. Two-1 in. expansion joints at curbs, 4 ins. total, filled with mixture of equal proportion of asphalt and pitch. Moisture content of untreated wood about 13 lbs. per cubic foot. Blocks steamed and a final vacuum used. Other details of treatment not reported. About $5.00 maintenance expense up to Nov. 1, 1916.

Paved in 1914.

Rochester, Minn. (East 5th St., Broadway to Central St.) 16500 sq. yds. Norway pine and tamarack. 6 rings per inch. 4 ins. x 5 ins. to 10 ins. x 3 in. deep blocks. 16-lb. treatment. Oil used was coal tar product. Analysis not reported. 5 ins. concrete foundation. 1 in. sand cushion. Paving pitch joints. 1 in. paving pitch-expansion joints at curbs. No record of details of treatment available, probably the same oil and treatment as Duluth, Minn., work, as the same manufacturer did both. No maintenance expense up to Nov. 1, 1916.

Spokane, Wash., (Trent Ave., from vacated Grant St. to Division St.)—13,000 sq. yds. tamarack. 11 rings per inch. 4 ins. x 6 ins. and 8 ins. x 3½ ins. deep blocks. 12-lb. treatment. Oil used was reported as creosote with average analysis as follows:

Specific gravity at 38°C	1.105

Distillation.

Up to 150°C	0
" " 200°C	0.4 %
" " 210°C	0.9 %
" " 315°C	27.3 %
Insoluble in benzol and chloroform	1.68 %

Condition of residue above 355° C. hard and brittle at 77° F.

5 ins. concrete foundation. ¾ in. sand cushion. Coal-tar pitch-paving joints. 2 ins. coal-tar pitch-expansion joints at curbs. Transverse expansion joints every 100 ft. Partly air-seasoned lumber. No preliminary steaming and vacuum. No final steaming. Final vacuum, 15 ins. at 180°F. for 30 minutes. $30.00 expense for maintenance up to Nov. 1, 1916.

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DOUGLAS FIR.

Paved in 1915.

Tacoma, Wash. (Puyallup Ave., from Pacific Ave. to "A" St.)—1866 sq. yds. Minimum 6 rings. 4 ins. deep blocks. 16-lb. treatment. Oil used was German and English oil. No report of analysis available. 6 ins.—1.3.6. concrete foundation. ⅛ in. 1:4 damp mortar cushion. Special paving joints, lower half depth asphaltic pitch, upper half 1:3 grout. 1 in. expansion joints of asphaltic pitch, and 20% cement at the curbs. Green lumber. No preliminary steaming or vacuum. Final vacuum, 24 ins. for one hour at 180°F. No maintenance expense up to Nov. 1, 1916.

SHORTLEAF NORTH CAROLINA PINE.

Paved in 1913.

Watertown, N. Y. (State St., from Pleasant to Colonade St.)—7500 sq. yds. Texture not reported. 3 ins. deep blocks. 18-lb. treatment. Oil analysis not reported. 6 ins. concrete foundation. ½ in. sand cushion. Sand-paving joints. 3 ins. prepared felt-expansion joints along curbs. No details of condition of lumber or treatment reported. This street has required $50.00 maintenance up to Nov. 1, 1916, to take care of bleeding and bulging. Pavement is now in good condition.

More details and further observation are desired on this work as it is the only acknowledged North Carolina pine pavement that the Committee succeeded in locating.

WOOD-BLOCK PAVEMENTS REPORTED BY DIFFERENT CITIES AS BEING FAILURES OR MOST UNSATISFACTORY.

1903-1916.

Minneapolis, Minn. (Third Ave., South from 5th St. to Grant St.)—14682 sq. yds., Norway pine, average run, some coarse and some fine. 4 ins. x 6 ins. to 10 ins. x 4 ins. deep blocks. 12-lb. treatment. No oil analysis. Oil reported under name of Kreodone. 6 ins. concrete foundation. 1 in. sand cushion. Some pitch-paving joints and some cement grout. 1 in. bituminous-expansion joints at curbs. No details of condition of lumber or process of treatment are available. This pavement is failing through decay of blocks as the result of insufficient penetration of the oil into the sap wood. The street will probably be resurfaced eventually with wood blocks of better quality, better oil, and more thorough treatment.

On Nov. 1, 1916, after 13 years of service the condition of this pavement is not so extremely poor as to necessitate resurfacing.

1905-1916.

Duluth, Minn. (First St., from 2nd Ave., East to 6th Ave., West.)—12,000 sq. yds.

Report of 1915 Committee shows this pavement as Tamarack, but the City Engineer now states that all kinds of wood were used.

The size of blocks is not stated. The 1915 report shows that 3 ins., 3½ ins. and 4 ins. deep blocks have all been used in Duluth. There is no record of the kind of oil used or quantity injected. 6 ins. concrete foundation. 2 ins. sand cushion. Bituminous-paving joints. No details of condition of lumber or process of treatment available.

On Nov. 1, 1916, after 11 years, this pavement showed signs of wear, but is still in service.

1906-1916.

Springfield, Mass. (Main St., from Bliss St. to William St.)—6460 sq. yds. black gum. 3 ins. x 6 ins. to 10 ins. x 3½ ins. deep blocks. 20-lb. treatment. Oil stated to be creosote; no analysis available. 5 ins. portland cement-concrete base. Dry mortar cushion. Cement grout-paving joints. 1 in. pitch-expansion joints along curbs, and transversely at intervals not stated. Lumber was air-seasoned and not steamed. A preliminary vacuum of 26 ins. at 175° to 200° F. was used. There was no final steaming or vacuum. This pavement is a natural failure, due to excessive wear after 10 years of service. The street will probably be resurfaced with yellow pine. It is reported that most of the wood-block pavements in Springfield show considerable wear and roughness with 10 years' service under traffic conditions existing there. During the past 10 years one side of this street between street-car tracks and

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curbing has been renewed for part of the length. A portion of Main St. pavement adjoining street-car tracks between Liberty St. and Lyman St. laid in 1901, was taken up in 1912 on account of excessive wear and roughness after 11 years of service.

1906-1913.

Sioux City, Iowa. (Fourth St., from Pearl St. to Iowa St.)—20,000 sq. yds. Norway pine and tamarack. Texture not known. 4 ins. x 8 ins. x 3 ins. deep blocks. 16-lb. treatment. No analysis of oil available. Oil stated to be heavy creosote from distillation of coal tar. 6 ins. foundation of natural cement and limestone aggregate. 1 in. sand cushion. Paving joints thought to be bituminous. ½ in. expansion joints, two in each gutter. The 1913 relaying was on a 1 in. dry mortar cushion with bituminous paving joints. No details of condition of lumber and process of treatment available; specifications were quite general, and it cannot be told now just what was done. In 1913 after 7 years' service this pavement was relaid, using such of the old blocks as were good, and the remainder of new blocks. Street should now (Nov. 1, 1916), be entirely repaved, but it is not expected to use wood block for the resurfacing.

1907 and 1908-1916.

Chicago, Ill. (Lincoln Ave., from Wrightwood Ave. to Irving Park Boulevard.)—35,240 sq. yds. longleaf yellow pine, minimum 6 rings. 4 ins. x 5 ins. to 10 ins. x 4 ins. deep blocks. 16-lb. treatment. Oil analysis not reported. Oil stated to be Kreodone—creosote-paving oil. 6 ins. portland cement-concrete foundation. 1 in. sand cushion. Bituminous cement-paving joints. 1 in. expansion joints of same material at curbs. ½ in. transverse joints every 100 ft. Lumber was partially seasoned. Blocks were steamed for 1½ hours at 200° to 220° F. 20 ins. vacuum for 1¾ hours at 220° to 145° F. No final steaming or vacuum. This pavement failed on account of moisture or water seeping between brow along street-car rail, and washing cushion from under blocks; also from carelessness in not properly providing for expansion when laying the blocks. About 2036 sq. yds. of this pavement have been relaid up to Nov. 1, 1916.

1909 and 1910-1916.

Albert Lea, Minn. (Main St. [1909], Clark St. [1910]).—Norway pine and tamarack. 4 ins. x 4 ins. to 9 ins. x 3 ins. deep blocks. 16-lb. treatment. No record of type of oil used. 5 ins. and 6 ins. concrete foundation. 1 in. sand cushion. Bituminous paving joints. 1½ ins. and 1 in. bituminous-expansion joints at curbs. No report of condition of lumber and details of treatment. These pavements have given trouble on account of heaving, due to imperfect treatment of blocks, and poor filler and expansion joints. It is stated that wood-block pavements expand during cold and wet weather and that a pitch filler has no expansion qualities during such period. It is proposed to avoid future trouble of this kind by using an asphaltic joint filler, and having competent inspection. No records of maintenance available.

1909-1916.

Delaware, Ohio. (Winter St., from Franklin St. to Elizabeth St.)—This is the oldest wood block pavement in Delaware. Longleaf yellow pine, 90% heartwood. 3 ins. x 6 ins. to 8½ ins. x 3 ins. deep blocks. 16-lb. treatment. No record of type of oil used. 6 ins. 1.3.6. concrete foundation. 1 in. sand cushion. Sand-paving joints, except tar for 2 ft. next to curb. 2 ins. tar-expansion joints at curbs. The street is 34 ft. wide between curbs. ½ in. transverse tar joints every 50 ft. No record of condition of lumber and details of treatment. This pavement gives trouble on account of buckling, and at this date (Nov. 1, 1916), some pieces are 3 ins. to 6 ins. high. It is stated that it is doubtful if the blocks received full 16-lb. treatment. It is proposed to avoid future trouble of this kind by using tar-paving joints instead of sand, and inspecting the treatment at the plant. This street does not require resurfacing after 7 years' service, and the cost of maintenance to Nov. 1, 1916, is reported as amounting to $100.00.

1910-1912 and 1914.

Bridgeport, Conn. (State St., from Main St. to Broad St.)—1700 sq. yds. longleaf yellow pine. Minimum 5 rings, average 8. 3 ins. x 5 ins. to 8 in. x 3½ ins. deep blocks. 16-lb. treatment. No record of type of oil used. 6 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. ¾ in. pitch-expansion joints at curbs. ½ in. transverse pitch joints every 75 ft. No report of condition of lumber and details of treatment. Trouble in this pavement occurs at crossovers within trolley section. The movement of the track

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produces leaks in the pavement, and frost does the rest. This pavement was taken up at the trolley special work in 2 to 4 years after it was laid. No record of cost of maintenance available. It is proposed to remedy the situation by using improved granite block for the trolley section.

1911-1916.

Spokane, Wash. (Monroe St. Bridge.)—3,000 sq. yds. fir. 11 rings per inch. 4 ins. x 6 ins. to 8 ins. x 4 ins. deep blocks. Treated with avenarius carbolineum; quantity not stated. Concrete foundation; depth not stated. 1 in. sand cushion. Asphalt-paving joints. 2 ins. asphalt-expansion joints at curbs and transversely 100 ft. apart. Lumber was partly air-seasoned. No steaming or vacuum, either preliminary or final. Trouble is due to bulging attributed to insufficient treatment permitting high absorption of moisture. Bridge will be resurfaced with wood block of 16-lb. treatment, which is expected to correct the difficulty. Maintenance expense has been $500.00 up to Nov. 1, 1916.

1912-1916.

San Angelo, Tex. (Chadbourne, Beauregard and Concho Sts.)—43,000 sq. yds. yellow pine. 4 ins. x 6 ins. to 8 ins. x 3 ins. deep blocks. Treated with 20 lbs. of oil; type not reported. 5 ins. concrete foundation. 1 in. sand cushion. Sand-paving joints. ⅝ in. asphalt-expansion joints at the curbs. No record of condition of lumber or details of treatment. The trouble with these pavements is excessive shrinkage, owing to long dry seasons, improper creosoting and sand-paving joints. Pavement has cost 10c per sq. yd. for maintenance. It is expected to relay the blocks, using asphalt filler for the paving joints to correct the difficulty.

1912 and 1913-1916.

Charleston, S. C. (Phillip St., from Calhoun to Vanderhorst St., and King St., from Ann St. to Columbus St.)—2,000 sq. yds. and 7,891 sq. yds. respectively. Mixed southern pine. Texture not specified. 3 ins x 8 ins. x 3 ins. blocks. 16-lb. treatment. Specifications called for coal-tar product free from adulteration. 1.10 to 1.14 gravity at 38°C. Insoluble in benzol and chloroform 3½% maximum. Distillation requirements 2% maximum up to 150°C. 30 to 40% up to 315°. Wood air-dried, mixed loblolly, shortleaf and longleaf pine. Treatment, live steam, average temperature 250° F., held for average of 5½ hours. Average vacuum, 23 ins. mercury; average duration 1¾ hours. Oil treatment, average maximum temperature 205°F.; maximum pressure, 150 lbs.; average duration 2½ hours. No steaming or vacuum after treatment. No oil analysis. 1 in. sand cushion. Sand-paving joints. 1 in. bituminous-expansion joints at each curb. The creosoted wood blocks in these streets have been decayed badly. The contractor has a local representative who makes repairs as defects show up. The cost of this has been considerable, but the exact amount is not known. The pavements are still under guarantee and the city is trying to reach a settlement with the contractor. There has also been trouble from bulging on these streets. The City Engineer says the remedy is to "get better blocks." This failure has been written up with illustrations in the "Engineering News," Feb. 3, 1916, p. 205. Reference to it was also made in a paper by Dr. Hermann von Schrenk, published in the 1915 Proceedings, p. 192, of the American Society of Municipal Improvements.

1906-1916.

Boston, Mass. (Washington St., from Milk St. to Essex St.)—This street was paved in 1906 with black gum blocks. The trouble with this street has been that the blocks wore off round on the edges and corners, thus leaving the surface rough and cobbled similar to an old-style granite block. This failure is in litigation as the pavement carried a 10-year guarantee, and no details are available at this writing, therefore above report made on outside information.

1912-1916.

Memphis, Tenn. (Vance St., from Front St. to Fourth St.)—12,833 sq. yds. (including street railway area) southern longleaf yellow pine. Minimum 6 rings. 4 ins. x 5 ins. to 10 ins. x 3½ ins. deep block. 16-lb. treatment. Oil analysis not reported. Pure coal-tar product specified. 6 ins. concrete foundation. 1½ ins. sand cushion. Pitch-paving joints. 2 ins., pitch-expansion joints at curbs. Condition of lumber and details of treatment not reported. The trouble with this pavement is that the street-railway tracks pump water through foundation and shift the sand cushion. In some places the blocks now rest on the bare concrete and in other places the sand cushion is 6 ins. thick. Probably $1000 has been spent on this pavement up to Nov. 1, 1916, and it is estimated that $3500 more is necessary to put it in shape. It is pro-

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posed to take up the old blocks and relay them, using about 25% of new blocks. In relaying the pavement, the sand cushion will be removed and the blocks relaid on ½ in. of asphalt on a mortar coating. Practically no repairs of wood block have been needed in Memphis where car tracks do not exist.

1910-1916.

Billings, Mont. (Minnesota Ave., 26th to 29th Sts.)—10,000 sq. yds. eastern tamarack. 4 ins. x 4 ins. to 9 ins. x 3 ins. deep blocks, 16-lb. treatment. Heavy creosote. No analysis available. 5 ins. concrete foundation 1 in. sand cushion. Pitch-paving joints. Two 1-in. pitch-expansion joints at curbs, total 4 ins. Condition of lumber and details of treatment not reported. The trouble with this pavement is bulging in cold weather when blocks become wet. The treatment of these blocks was not inspected, and proper treatment was therefore not assured. Blocks were laid too close, and the pitch filler hardens in cold weather, thus forcing the blocks to bulge from expansion. $500 maintenance has been put on this street up to Nov. 1, 1916, and it is proposed to apply a carpet coat of thin oil as an experiment to remedy the trouble. Blocks show little wear.

1913-1916.

Paris, Tex. This city had 5500 sq. yds. of 4 ins. x 8 ins. x 3 ins. longleaf pine blocks laid on the Public Square in 1913. Blocks were laid on 5 ins. of gravel concrete. 1 in. sand cushion and bituminous-paving joints. 1 in. bituminous-expansion joints were placed at the curbs. Paris was swept by fire on March 21, 1916, the greater part of the city being destroyed, and for this reason no detail records of the treatment of these blocks are available. Until shortly before the fire this wood-block pavement had never given any trouble, but was then in such a condition that any hard rain would cause it to bulge and blow up. The fire burned the pavement in places as much as ½ in. deep.

Brooklyn, N. Y.—There have been two wood-block failures in this city. One was a pavement laid on a sand base by a land improvement company, and went bad, owing to the fact that there was no concrete under it. The other street that failed was on Broadway. This pavement was replaced by improved granite blocks. The question of the guarantee on the wood block surface is now a matter of litigation, and the details of this failure cannot be reported at this time. This street should be noted for future investigation, and report after the guarantee has been passed by the courts.

Dallas, Tex.—The Committee has received a general report that the oldest blocks have begun to decay, and considerable expense is now incurred in taking up single rotten blocks here and there and replacing them with good blocks. It is reported that many of the blocks were insufficiently treated, owing to the fact that heavy refined coal-tar oil was used. As a remedy, the Engineer suggests the use of a creosote distillate oil. This opinion is based upon the fact that one pavement in Dallas, about 5 years old, treated with a pure English creosote distillate oil of about 1.045 gravity, is giving satisfaction.

The Committee has not, as yet, received an official report relative to any of the wood block pavements in the Borough of Manhattan, New York, that have failed, but thinking that the members attending this convention might find it of interest to examine some of the poorer pavements, we give below a list of these streets with unofficial comment as to the probable causes of the defects which have developed in them. All of these streets are under very heavy traffic in the lower part of Manhattan. The amount of repairs is stated for each street.

WOOD-BLOCK PAVEMENTS IN NEW YORK CITY.

Laid in 1904.

Warren St., Broadway to Church St.—1740 sq.yds., 18% of repairs in 1915. This street has been in a torn-up condition, owing to the installation of service pipes, etc., for several years.

Laid in 1905.

Chambers St., Broadway to West St.—25% of repairs in 1913 and 1914. This street has been constantly torn up for installation of various pipe-lines, etc.

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Jay St., Hudson St. to Staple St.—535 sq. yds., 12% of repairs in 1913 to 1915.

Reade St., Center St. to West St.—3802 sq. yds., 52% of repairs in 1913 to 1915. Has been constantly torn up for several years.

Staple St., Jay St. to Harrison St.—370 sq. yds., 65% of repairs in 1913 to 1915. Committee not familiar with conditions. Data taken from "Municipal Blue Book."

Laid in 1906.

Battery Place, Broadway to West St.—8200 sq. yds., 20% of repairs in 1915. This pavement is defective from the manner in which it was laid. It has shifted badly on the sand cushion.

Dey St., Greenwich St. to West St.—3371 sq. yds., 14% of repairs in 1915. Has been in a constantly torn-up condition for several years for the installation of pipe-lines, etc.

Greenwich St., Battery Place to Dey St.—9681 sq. yds., 16% of repairs in 1913 and 1914. Has been torn up a great deal for the installation of pipe-lines, etc.

Greenwich St., Vesey St. to Chambers St.—4571 sq. yds. Had 31% of repairs in 1915. Has been constantly torn up for the installation of service-pipes, etc., for several years.

Vesey St., Broadway to West St.—4934 sq. yds. Had 13% of repairs in 1913 to 1915. Has been constantly torn up for several years for the purpose of installing pipe lines, etc.

Laid in 1909.

State St., Whitehall St. to Bowling Green.—6533 sq. yds. Had 51% of repairs in 1913 to 1915. Pavement originally laid with a mixture of black gum and red gum blocks. Red gum blocks did not take treatment.

One of the foregoing cities claims that the wood-block pavement has not been satisfactory, because at the time of a destructive fire in the city this pavement was burned and a great deal of the oil appeared to have been cooked out of the blocks. While these blocks were in excellent shape before the fire they afterward became little better that untreated blocks, absorbing water after every rain and buckling badly.

We hardly feel that this can be considered a defect in the wood-block pavement, for we have several cases on record where wood-block pavements have passed through very destructive fires and were little injured, as for instance, in Philadelphia, Pa., two piers, Nos. 34 and 35, were paved with wood-block in 1910. The blocks were long leaf yellow pine 3 inches x 8 inches x 3 inches, 16-pound treatment water-gas tar on concrete foundation. Blocks were given preliminary steaming and vacuum, but no final steaming or vacuum was used. In 1914 Pier No. 35 was burned, which subjected these blocks to a severe fire test. The heat was so great that the structural steel-work was fused and the greater portion of the fused and burning material fell upon the wood-block floor. After the removal of the debris it was found that the wood-blocks were charred ⅛ in to ¼ in. in depth under direct flames, and ¾ in. to 1 in. where touched by the fused steel. In reconstructing the pier the flame-charred blocks were scraped and allowed to remain in service, while the blocks more deeply charred by the hot steel were turned over and relaid. This burned floor has

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cost no more for upkeep since that time than the wood-block floor on the adjoining Pier No. 34.

In Baltimore, Md., several wood-block pavements went through the great conflagration of 1904 in that city without any material damage, and many of them are giving good service today, 12 years after the fire.

The Committee wishes to apologize for the hastily drawn up report which has been presented this year, but it has been impossible in the short time at its disposal to do much more than give the bare facts reported by the various city officials.

We recommend that future committees on service tests of wood-block pavements endeavor to fill out the missing information on the streets herein reported, and to keep a record from year to year of the behavior of these streets; especially examine more closely into the streets which have failed and endeavor to find out what has been the actual cause of these failures. We would advise that these examinations, where possible, be made by members of the Committee in person, so that an accurate report can be made on them and a means devised to prevent their recurrence in future paving work. We also advise that the Committee endeavor to get full reports from the cities that have not replied. This might be done in many cases by members of the Committee visiting the cities in person.

As we have had but a few reports on Norway pine, tamarack and black gum, we would advise that future Committees obtain the names of more streets paved with these woods for the purpose of studying their action under different kinds of traffic and conditions.

In the case of failures in pavements, we most strongly advise that future committees obtain traffic census of the street as well as records of cuts, etc., that might be factors in the life of the pavement.

The present Committee has been unable to collect any data on wood-block paving of bridges and factory floors. This should also be looked into by future committees, and a study made of the best treatment and kind of oil to meet these conditions.

A. W. DOW,
J. C. WILLIAMS,
ERNEST G. DRAPER.

MR. M. K. TRUMBULL: Does the report contain recommendations?

THE PRESIDENT: You will see those right there at the last.

MR. M. K. TRUMBULL: Nothing in the way of conclusions or results of this test?

THE PRESIDENT: No. Gentlemen, what do you want to do with this report?

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MR. WALTER BUEHLER: I want to clear up the reasons for two of the failures mentioned. One is at Duluth, Minn., and the other is Sioux City, Ia. In Duluth, Minn., a 4-in. block was used. The contractor in putting in his concrete failed to provide the space for the cushion. He had just 4 ins. from the pavement to the top of the manhole covers, and 4 ins. to the top of the catch-basins. The matter was taken up with the City Council at the time. We tried to get them to cut down the size of the blocks. They would not do that. We wanted them to cut out the manholes and raise the grade of the street, and they would not do that. They finally worked out the proposition of starting from the center of the street with no sand cushions and feathering it out to the curb to about 1 inch. This no doubt will account for the failure. Part of the blocks were laid directly on a rough concrete, and part of them on a sand cushion. The street was rough right from the very beginning. Sioux City, Ia., re-surfaced an asphalt street. The concrete was very rough, and therefore the sand cushion would vary anywhere from ½ in. to 2 ins., which I believe will account for the failure. I believe it important to get at the real reason for the failure whenever possible.

THE PRESIDENT: Are there any further comments? Any information that you may have regarding the streets that have been mentioned here?

MR. A. W. DOW: I would like to say, as a member of the Committee, that this report should be considered as the beginning of service tests on wood blocks, and it would be of great advantage to the members of the Committee, and of course to the Association, if the individual members of the Association would look up failures or look up the good pavements and make personal reports on them. We would then feel that the source of information was in men who knew something about the business, rather than taking the report and conclusions of a city engineer who may be prejudiced. I think it would be conferring a great favor upon the Association if individual members will pick out pavements in their own locality and in their leisure time make reports to the Committee on either the failure or the success of the pavements.

MR. F. J. ANGIER: Mr. President, I would like to ask the Committee who there is in Baltimore that knows anything about this paving that went through the 1904 fire and is serviceable today. I took the trouble to look into that a little and no city official there that I can find knows anything about it.

MR. A. W. DOW: I may be responsible for that. I have been inspecting for Baltimore for the last 10 or 12 years all classes of paving material, and Mr. Fiedler, the old City Engineer, told me of that. I

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was also present in Baltimore directly after the fire and saw some of the pavements.

MR. F. J. ANGIER: Did you see this pavement lately?

MR. A. W. DOW: They took the pavement up and turned the blocks over.

MR. F. J. ANGIER: Do you know what street it was on?

MR. A. W. DOW: I could not tell you now, but I can find out for you.

MR. F. J. ANGIER: I would like to look at it.

MR. J. C. WILLIAMS: It is pretty well authenticated. The people who laid the blocks got quite an advertisement out on it at the time of the fire.

THE PRESIDENT: Are there any further remarks?

MR. J. C. WILLIAMS: Mr. President, I move the acceptance of the report as information. That is all that it is compiled for, and I would urge the carrying out of the recommendations, especially regarding those best streets. They cover quite a range of construction and oil and depth of blocks, and if they are conscientiously followed up at intervals of two or three years, it will only be a short time, comparatively speaking, before we will have some definite information as to what constitutes a good wood-block pavement.

MR. M. K. TRUMBULL: I will second that motion, providing Mr. Williams will be willing to add to it that we instruct the Committee for the coming year to summarize the detailed results, which are secured, and if possible to submit conclusions.

THE PRESIDENT: All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

I would just like to say that due to a misunderstanding this Committee did not get to work until very late in the year. It had only a very few weeks to prepare this report, and I think the Association should understand that feature. I believe you will agree with me that it is a most excellent report, considering the time the Committee has had.

We will now have the report of the Committee on Wood-Block Paving. The members of this Committee are: Mr. C. H. Teesdale, Chairman, Mr. Walter Buehler, Mr. F. W. Cherrington, Mr. F. P. Hamilton, Mr. H. S. Loud, Mr. H. M. Newton. Will the members of the Committee kindly take their places on the rostrum?

MR. C. H. TEESDALE: Mr. Chairman and Members of the American Wood-Preservers' Association: Before I take up this report

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I wish to report two or three changes that the Committee has made in the specification. In the pamphlet report, page 5, Section 4, second paragraph, eliminate the words "either preceded or," and on page 8, under "Filler," Section B, change 22½ to 18%. Section B will then read:

Free carbon shall not be less than 18% nor more than 37%.

The method of analysis for free carbon will be changed to conform with the report of the Committee on Preservatives. In the pamphlet report on page 9, Specifications for Treating Douglas Fir Paving Blocks, eliminate all of the last sentence.

(These changes have been made in the report as published on pages 451-461.)

REPORT OF THE COMMITTEE ON WOOD-BLOCK PAVING.

To the Members of the American Wood-Preservers' Association:

The instructions of the Executive Committee to the Committee on Wood-Block Paving for 1916 were as follows:

1. Collect and compile all specifications and definitions concerning wood-block paving which have been approved by the Association. Recommend such revisions as may be necessary and present for insertion in the Manual.

2. Prepare a specification for the treatment and laying of creosoted wood blocks. This does not include specifications for the preservative. The Executive Committee desires that, aside from making it clear that a firm foundation is necessary for satisfactory service from a wood-block pavement, the Committee confine its specifications to the superstructure of a roadway or floor. This includes the surfacing of the sub-structure, the cushion, the blocks, and the filler between them. The composition of the sub-structure is not within the province of the American Wood-Preservers' Association.

3. Present recommendations for future work to be undertaken by your Committee.

The Committee has been unable to find a record of the Association having approved any specification or definitions concerning wood-block paving.

During the past year a meeting was called at Brooklyn, N. Y., which the members of six associations interested in wood-block paving were invited to attend. This meeting was presided over by George W. Tillson. Representatives of the following associations were present: American Wood-Preservers' Association, American Society of Municipal Improvements, American Society for Testing Materials, American Society of Civil Engineers, American Railway Engineering Association, and the Southern Pine Association. The object of the meeting was to endeavor, if possible, to have the committees who were working on wood-block paving specifications present identical specifications to their

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respective associations. The meeting was successful in this respect, and the members of the various committees agreed to present identical specifications on timber, size of blocks, treatment, handling after treatment, and inspection. The remaining items (cushion, foundation, laying, filler) were not considered by the joint meeting.

Your Committee very strongly recommends that the Association adopt the specifications recommended by this joint meeting without material change. The Committee feels that it will be a big step in advance if uniform specifications are adopted by the different associations interested.

The specification which we are recommending this year is substantially the same as was submitted last year as information. Only minor changes have been made, the most important of which concerns the method of applying the oil under pressure.

Your Committee differed from the opinion of the joint meeting concerning the method of computing absorption of preservative, but has felt that for uniformity we should not insist upon including this in the standard specifications. In our opinion this should read as follows: (page 456, paragraph 4, line 5):

> In any given contract the blocks shall contain an average of not less than 16 lbs. of water-free oil per cubic foot of wood at the completion of the treatment. Not less than 15 nor more than 17 lbs. per cubic foot will be permitted in a given charge.

In order to obtain at least 16 lbs. per cubic foot in any charge one should bear in mind that the average absorption of several runs will usually be between 16.4 and 16.7 lbs. per cubic foot.

In addition to the specifications offered last year, one on pitch filler has been added. In this specification it was the aim of the Committee to obtain a material having a melting point of about 145° F. The lower melting point recommended for fillers on small jobs, or where small kettles are used, was intended to allow for unavoidable evaporation, and should give a filler having approximately 145° F. melting point at the time of use. The Committee believes that either coal-tar or asphalt fillers may be used. Through lack of available information, however, we have been unable to submit a satisfactory specification for asphalt fillers.

The Committee does not approve of the use of sand filler or sand cushion. Successful pavements are in existence where these forms of construction were used. However, there have been so many failures and cases of trouble directly caused either by sand filler or sand cushion that we feel the risk of using them is not offset by their lower cost.

Sand fillers are not waterproof and, hence, permit water to reach the base of the blocks. This often causes trouble from expansion. If the blocks dry out and shrink, the sand settles down in the spaces

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between the blocks, creating the possibility of further trouble if they later become wet and expand.

Sand cushion often causes trouble, especially where there is vibration, by shifting and creating an uneven surface.

It was not feasible for the Committee to prepare a specification for crown that would fit all conditions. The following may be used satisfactorily for streets paved with wood block on which there are no street-car tracks, and which are between 20 ft. and 50 ft. in width.

Height of crown in feet shall be 0.013 of the paved width in feet. This formula gives too much crown for streets wider than 50 ft., or those on which there are street-car tracks. It does not give enough crown on streets less than 20 ft. wide.

It is the opinion of the Committee that if these specifications are carefully followed the resulting street will not bleed excessively, nor should there be serious expansion troubles. The method of forcing in the oil should give the maximum penetration obtainable with the absorption used. These specifications require from 25 to 50% more time than is commonly required for creosoted blocks, but we feel that the possibility of increasing durability and lessening expansion and bleeding troubles warrants this course. City engineers and others who have occasion to use these specifications should bear in mind this item of time, and be sure that it is spent upon treatment. From 10 to 12 hours are required to properly treat southern pine blocks by these specifications.

Your Committee has been impressed with the sentiment gradually crystallizing among engineers and manufacturers in favor of an absolutely rigid and water-tight type of pavement construction. Much favorable attention has been directed to a practice which is, unfortunately, not so common in this country as abroad; namely, that of laying the blocks on a smoothly finished concrete base, and particularly to that form wherein the blocks were either dipped in pitch immediately before laying, or where set in hot pitch swabbed upon the concrete base. Recent examination of some old pavements so constructed has furnished the most convincing argument in favor of such a type. It seems that where this type of construction has been abandoned it has been done solely on account of the fact that it was thought possible to reduce the cost of construction without detrimental effect. In fact, the increased cost seems to be the chief obstacle to its more general adoption.

Within the last two years a new method has been introduced which your Committee believes to be of great importance to the future of this industry. It consists simply in coating the smoothly finished concrete base with bituminous cement, and allowing this to get cold and harden before attempting to set the blocks on it. The expedient

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of allowing the cement first to cool and harden before setting the blocks substantially removes the objection of high cost, and it also removes the objection in regard to difficulty of replacing faulty blocks where set in hot pitch. Furthermore, it accomplishes the same results as if the blocks had actually been set while the pitch was still hot, as it will be found that after a day or so the blocks all adhere firmly to the base.

A series of comparative tests are now in progress to determine safe loads on typical pavement sections made with and without cushion. While incomplete, these tests appear largely to favor the rigid type of construction. They also seem to indicate the feasibility of using a shallower wood block in connection with a smooth base without in any way sacrificing strength.

Your Committee is not prepared to offer a definite specification for this type as a standard, but would earnestly recommend the matter to the attention of the individual members of the Association who are interested in this field, and to the serious consideration of next year's Committee.

Recommendations for Future Work.

Your Committee recommends that the following work be undertaken by the Committee on Wood-Block Paving for the coming year:

1. Recommend specifications for laying wood blocks in street-railway tracks.
2. Determine whether western larch should be included in the specification as a wood suitable for wood-block paving, and if favorably reported upon recommend a specification for treatment if possible.
3. Recommend specifications for treating Douglas fir-paving blocks.
4. Recommend specifications for asphalt filler.
5. Investigate laying blocks on a bituminous paint coat, and if favorable recommend a specification for this type of construction.

SPECIFICATION FOR CREOSOTED WOOD-BLOCK PAVING.*

Timber.

1. KIND: *The wood from which the blocks are to be manufactured shall be southern yellow pine, Douglas fir, tamarack, Norway pine, hemlock, or black gum. Only one kind of wood shall be used in any one contract. The blocks must be sound and must be well manufactured, square butted, square edged, free from unsound, loose or hollow knots, knot holes, worm holes, and other defects such as shakes, checks, etc., that would be detrimental to the blocks.*

*This specification is intended for street work exposed to the weather. It is not intended to be used for flooring or inside work where the blocks are not exposed to the weather.

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In southern yellow pine or Douglas fir the number of annual rings in the 1 in. which begins 2 ins. from the pith of the block shall not be less than six, measured radially, provided, however, that blocks containing between five and six rings in this inch shall be accepted if they contain 33⅓% or more of summerwood. In case the block does not contain the pith, the 1 in. to be used shall begin 1 in. away from the ring which is nearest to the heart of the block. The blocks in each charge shall contain an average of at least 70% of heartwood. No one block shall be accepted that contains less than 50% of heartwood.

Size of Blocks.

2. The blocks shall be from 5 to 10 ins. long, but should preferably average two times the depth; they shall be† *. . . . inches in depth. They shall be from 3 to 4 ins. in width, but in any one city block all of them shall be of uniform width. A variation of 1/16 in. shall be allowed the depth and ⅛ in. in the width of the blocks from that specified. In all cases the width shall be greater or less than the depth by at least ¼ in.*

Preservatives.

3. (Specified by Committee on Preservatives).

Treatment.

4. The timber may be either air-seasoned or green, but should preferably be treated within three months from the time it is sawed. Green timber and seasoned timber shall not, however, be treated together in the same charge. The blocks shall be treated in an air-tight cylinder with the preservative hereinbefore specified. In all cases, whether thoroughly air-seasoned or green, they shall first be subjected to live steam at a temperature between 220° and 240° F. for not less than two hours, nor more than four hours, at the discretion of the treating-plant operator, after which they shall be subjected to a vacuum of not less than 22 ins., held for at least 1 hour. While the vacuum is still on, the preservative oil, heated to a temperature of between 180° and 220° F., shall be run in until the cylinder is completely filled, care being taken that no air is admitted. Pressure shall then be gradually applied not to exceed 50 lbs. at the end of the first hour nor 100 lbs. at the end of the second hour, and then maintained at not less than 100 lbs. nor more than 150 lbs. until the wood has absorbed the required amount of oil.*‡

†The Committee recommends blocks 4 ins. in depth for very heavy traffic streets; blocks 3½ ins. in depth for moderate traffic streets. For light traffic streets blocks 3 ins. in depth may be used, but where 3 in. blocks are used no block shall be longer than 8 inches.

*In no case shall a steam pressure of 20 lbs. per square inch be exceeded.

‡This treatment is recommended for yellow pine only. It is probably also suited to Norway pine, hemlock, black gum and tamarack, but not to Douglas fir. Further recommendations on the treatment of these species are reserved for the future.

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After this a supplemental vacuum shall be applied in which the maximum intensity reached shall be at least 20 ins., and shall continue for a total period of not less than 30 minutes. If desired this vacuum may be followed by a short steaming period.

In any charge, the blocks shall contain at least 16 lbs. of water-free oil per cubic foot of wood at the completion of the treatment. The blocks after treatment shall show satisfactory penetration of the preservative, and in all cases the oil must be diffused throughout the sapwood. To determine this at least 25 blocks shall be selected from various parts of each charge, and sawn in half at right angles to the fibers through the center, and if more than one of these blocks show untreated sapwood the charge shall be re-treated. After re-treating, the charge shall be again subjected to a similar inspection.

The surface of the blocks after treatment shall be free from deposits of objectionable substances, and all blocks that have been materially warped, checked or otherwise injured in the process of treating shall be rejected.

Handling Blocks After Treatment.

5. The blocks shall preferably be laid in the street as soon as possible after being treated. If they cannot be laid immediately provision shall be made to prevent them from drying out by stacking in close piles and covering them, and, if possible, by sprinkling them thoroughly at intervals. In any case, where they are not laid as soon as they are received on the street they shall be well sprinkled about two days before being laid under the direction of the purchaser. It is important to have the wood sufficiently wet to be swelled to its maximum size before it is laid.

Inspection.

6. All material herein specified and processes used in the manufacture of the blocks therefrom shall be subject to inspection, acceptance, or rejection at the plant of the manufacturer, which shall be equipped with all the necessary gauges, appliances, and facilities to enable the inspector to satisfy himself that the requirements of the specifications are fulfilled.

The purchaser shall have the further right to inspect the blocks after delivery upon the street for the purpose of rejecting any blocks that do not meet these specifications, except that the plant inspection shall be final with respect to the kind of wood, rings per inch, oil, and treatment.

Foundation.

7. The foundation for the pavement shall be of concrete, made in accordance with the specifications of the purchaser for concrete-pave-

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ment foundation. At no place shall the surface of the finished concrete vary more than ½ in. from the given grade.

Mortar Cushion.

8. Upon the concrete foundation shall be spread a layer of thoroughly mixed mortar made of one part of Portland cement of the character provided for in the foundation, and four parts of sand. Only sufficient water shall be added to this mixture to insure a proper setting of the cement, the intention being to produce a granular mixture which may be raked to the desired grade. The mortar shall be spread in place on the foundation immediately in advance of the laying of the blocks. The mortar bed shall be raked to the approximate grade and struck by templates to a surface parallel to the grade and contour of the finished pavement. The finished mortar bed shall have an average thickness of not over ¾ in., and shall in no case be over 1 in. in thickness.

Laying the Blocks.

9. Upon the bed thus prepared the blocks shall be carefully set with the fiber of the wood vertical in straight parallel courses, leaving a space next to the curb 1 in. in width for the expansion joint.

The blocks shall be laid by setting them hand-tight on the base or cushion. No joint shall be more than 3/16 in. in width. They may be driven together every ten courses to keep the rows straight. Nothing but whole blocks shall be used, except in starting a course, or in such other cases as the purchaser may direct; and in no case shall the lap joint be less than 2 ins. Closures shall be carefully cut and trimmed by experienced men.

The angle of course to the curb shall be fixed at the discretion of the purchaser.

After the blocks are placed on the mortar bed they shall be rolled parallel and diagonally to the curb by a tandem roller weighing between 4 and 7 tons until the surface becomes smooth and is brought truly to the grade and contour of the finished pavement. The rolling shall be completed before the mortar bed has set. All mortar that has set before the blocks are in place and rolled shall be discarded and replaced by fresh mortar.

After the rolling is completed the joints between the blocks shall be filled with a bituminous filler. This shall preferably be done only when the temperature of the air is above 45° F. The filler shall be brought to the proper temperature and poured into the joints; and filler on the surface of the pavement must be spread as thinly as possible by means of squeegees. The filler shall be thoroughly worked into the joints between the blocks while hot, leaving no surplus on the pavement.

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The surface shall then be completely covered to a depth of about ½ in. with clean, coarse, dry sand, which shall be left upon the pavement.

OPEN-JOINT CONSTRUCTION.—*When the blocks are laid on streets having grades of 3% or over, it is desirable that the blocks be spaced by laying creosoted wood lath about 5/16 in. thick between each course. The space above the lath shall then be filled with heated crushed stone (containing no dust) and bituminous filler. The joints shall be poured about one-half full with the bituminous filler specified, care being taken to get none on the surface of the pavement. The crushed stone* shall then be swept into the joint, and the space around the stone filled with the bituminous filler to the top of the joint. It is essential, in open-joint pavement, to drive the blocks together every four rows to prevent tipping of the individual blocks.*

Filler.

10. Either coal-tar-pitch or asphalt fillers may be used. The following specifications shall be used for coal-tar-pitch fillers:

The pitch used as filler shall be obtained entirely from the distillation of coal-tar, and shall comply with the following requirements:

A. *Specific gravity at 77° F. (25° C.) shall not be less than 1.22 nor more than 1.34.*

B. *Free carbon shall not be less than 18% nor more than 37%.*

C. *Melting point shall not be less than 140° F. (60° C.) nor higher than 150° F. (65.5° C.) when determined by the half-inch cube method.†*

D. *When 100 grams of pitch are distilled to 670° F. (355° C.) in an 8-oz. retort, specific gravity of the distillate shall not be less than 1.07 at 100° F. (37.7° C.)*

SPECIFIC GRAVITY.—*Ten grams of pitch weighed in a Hubbard type specific gravity bottle whose water capacity at 77° F. (25 C.) has been determined. The pitch is introduced into the bottle in a liquid condition and weight taken after cooling. Freshly boiled water is added, and the temperature maintained at 77° F., water adjusted to mark, and bottle removed from bath and weighed. Weight of pitch divided by weight of water displaced equals specific gravity.*

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*It is very important to have the crushed stone heated, so that the filler will penetrate around them and make a solidly filled joint. If possible the stone should be heated to 350° F. before being applied. This may be done in the sand drum of an asphalt plant.

†On small jobs it is sometimes desirable to use pitch having a melting point from 135° to 145° F., because of the small kettles usually used, which are liable to raise the melting point considerably while the pitch is being heated.

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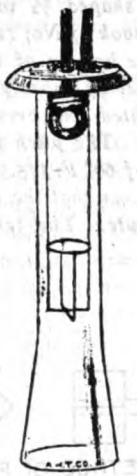
Insoluble in Benzol.

APPARATUS.—(A) *Extractor may be of the form shown below, or any similar form in which the pitch is subjected to direct washing by the boiling vapors of the solvent.*



(B) *Filtering medium may be either two thicknesses of S. & S. No. 575 or Whatman No. 5 hardened filter paper, 15 c.m. in diameter arranged in cup-shape by folding symmetrically; or alundum thimbles, flat bottom, 30x80 RA 98. If filter papers are used, prior to using they shall be soaked in benzol to remove grease, dried in a steam oven and kept in a desiccator until ready to be used. The filter-paper cup may be suspended in the extractor flask by a wire basket hung from two small hooks on the under surface of the metal cover of the flask.*

If the alundum thimble is used, it may be supported by making two perforations in the top of the thimble, and suspending from the cover by German silver or platinum wires.

METHOD.—*Weigh about 5 grams of pitch in a 100 c.c. beaker, add about 50 c.c. of pure toluol or pure benzol, (preferably the former) and digest on steam bath. Time of digestion should not exceed 30 minutes. Decant solution through the weighed filter cup, prepared as previously described, washing out beaker with hot toluol or benzol until clean, passing all washings through the filter. Then place the filter in the extraction apparatus.*

Extractor shall contain a suitable quantity of pure benzol. Sufficient heat to boil the solvent shall be provided by means of an electric heater or a steam bath.

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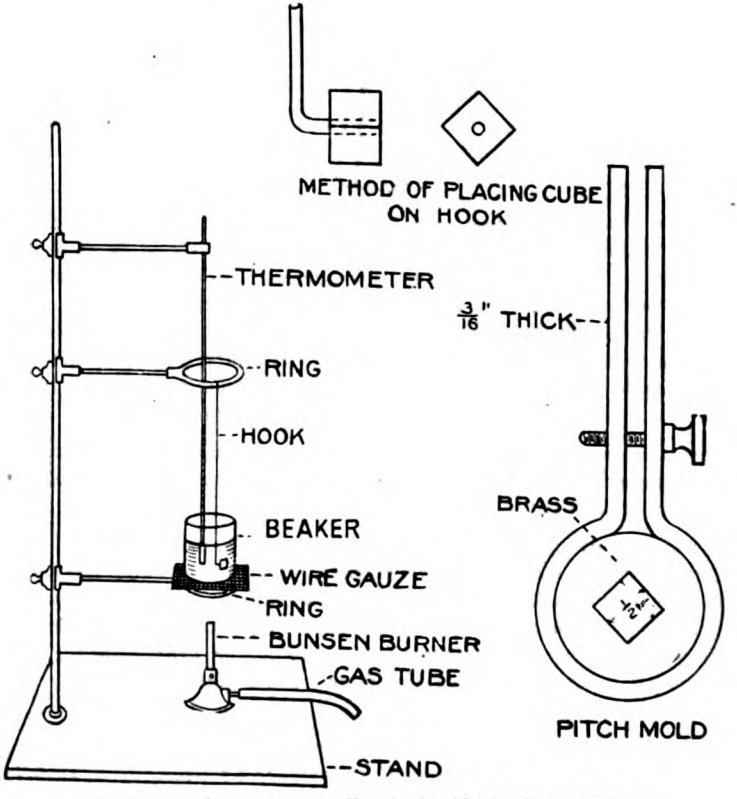
Continue the extraction until the descending solvent is practically colorless, and remove the filter cup and dry in steam oven until all solvent is driven off; cool in desiccator and weigh. The balance used for this purpose should be accurate to within 0.5 m.g.

MELTING POINT.—*A clean shaped ½ in. cube of the pitch to be formed in a mold, placed on a hook of No. 12 copper wire and suspended in a 600 c.c. beaker so that the bottom of the pitch is 1 in. above the bottom of the beaker. (A sheet of paper placed on the bottom of the beaker and conveniently weighted will prevent pitch from sticking to the beaker when it drops off.) The pitch to remain 5 minutes in 400 c.c. of water at a temperature of 60° F. (15.5° C.) before heat is applied. Heat to be applied in such manner that the temperature of the water is raised 9° F. (5° C.) each minute. The temperature recorded by the*



Arrangement of Apparatus for Testing for Melting Point of Pitch.

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thermometer at the instant the pitch touches bottom of beaker to be considered the melting point.

THERMOMETERS IN KETTLES.—*The kettles in which the filler is heated on the street shall be equipped with approved thermometers, and the pitch shall be heated to a temperature of not less than 250° F., nor more than 300° F., and shall be poured when at a temperature between these limits.*

NOTE.—Engineers should not use this specification as a whole, but should make a selection of material and method where more than one is indicated under the different headings.

SPECIFICATION FOR TREATING DOUGLAS FIR-PAVING BLOCKS.

(Presented as information.)

Douglas fir should not be handled in the same way as southern yellow pine. It has been found that steaming this wood is undesirable. The following specification is the one recommended by the West Coast Lumbermen's Association, and covers treatment only.

The material shall be treated green, effecting sufficient seasoning by boiling in the oil to admit of complete penetration by the preservative. Blocks shall be treated by the boiling process with 16 to 18 lbs. of coal-tar creosote per cubic foot of wood, which amount shall afterwards be reduced by expansion and vacuum to 10 to 12 lbs. per cubic foot.

The blocks shall be placed in the treating cylinder and the preservative introduced and heated to approximately 215° F. for 2 to 4 hours. The preservative shall then be drained off and a vacuum of 23 to 26 ins.* drawn to take out the surplus oil, vapors, gases, etc., from the wood cells. The vacuum shall then be broken by the introduction again of the preservative, which is then pressed into the wood at a temperature of 180° F. until the blocks have received from 16 to 18 lbs. per cubic foot. After the blocks have received the required amount of oil, the pressure shall be released, and the temperature of the oil gradually raised to 215° to 230° F., and held for 1 hour. This final heating expands the oil, vapors, and gases within the wood, and causes a certain amount of the preservative to be expelled, due to this expansion, and also effects further seasoning of the wood. A final vacuum of 23 to 26 ins. shall then be drawn.

C. H. TEESDALE, *Chairman*,
W. BUEHLER.
F. W. CHERRINGTON,
F. P. HAMILTON,
H. S. LOUD,
H. M. NEWTON,

*The preliminary vacuum in the above treatment may ordinarily be omitted. It is intended for an additional precaution against bleeding of the blocks where it is especially necessary to eliminate this objection.

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APPENDIX TO REPORT OF COMMITTEE ON WOOD-BLOCK PAVING.

The influence of the proposed treatment on the strength of paving blocks and the influence which the condition of the timber at time of test may have on strength test data.

By Clyde H. Teesdale,

In Charge, Section of Wood Preservation.

and

John A. Newlin,

In Charge, Section of Timber Tests,
Forest Products Laboratory, Madison, Wis.

Recently there has been considerable discussion on the strength of southern yellow pine blocks when treated in accordance with the methods required by the specification of the Committee on Wood-Block Paving. It has been contended that this treatment seriously weakens the blocks and hence it was felt desirable to conduct tests in which the strength of the blocks could be compared before and after treatment.

The timber for these experiments was obtained in two shipments, the first by purchase from the Kettle River Company, and the second being donated by the Chicago Creosoting Company. The first shipment was received in July, 1916, and stored under cover at the Laboratory, and at the time these experiments were made was in an air-dry condition. The second shipment was received just before the experiments were started and was green. Each of these shipments was divided into two portions, one of which contained blocks with from 50% to 65% of sapwood—considered as sap blocks—and the other containing from 5% to 15% of sapwood—considered as heart blocks.

Five sticks from each of the above groups of wood were selected and cut into paving blocks. Four blocks from each stick were selected for subsequent strength tests, two of them being used for treatment and the other two for controls. The control blocks and the treated ones were cut alternately from the end of the stick.

The preservative used in these experiments was furnished by The Barrett Company, and consisted of a tar and creosote paving oil which would pass the specification presented this year by the Committee on Preservatives.

The treatments were made in the 1½ ft. by 4 ft. cylinder at the Forest Products Laboratory. Two runs were made, the air dry and green blocks being treated separately. A total of 48 blocks were included in each treatment, additional blocks from each of the groups described above being included to provide blocks for further strength tests than those planned for in case this was found advisable.

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The treatments were made in accordance with the specification of the Committee on Wood-Block Paving, with the exception that the blocks were removed from the cylinder before injection with preservative in order to obtain data on the amount of water gained or lost during the steaming and vacuum period. From 10 to 12 minutes were required for removing the blocks, weighing them, and returning them to the cylinder. The treatment of the air-dry blocks was as follows:

Steamed for four hours at 240° F. and 10 lbs. steam pressure. The temperature during this period did not exceed 241° F. Steaming was followed by a vacuum of 26 ins. maintained for 1 hour. At the end of this period the blocks were removed, weighed, and returned to the cylinder, and a further vacuum of 26 ins. maintained for 30 minutes. The oil was then admitted to the cylinder without releasing the vacuum.

The pressure starting with 0 was increased by 5-lb. increments every 6 minutes until it had reached 50 lbs. at the end of 1 hour and 100 lbs. at the end of two hours, when the pressure was released and the oil drained from the cylinder.

A vacuum of 26 ins. was then applied and maintained for 30 minutes, when it was released and a steam pressure of 10 lbs. per square inch was applied and maintained for 30 minutes. The temperature during this period did not exceed 240° F. A vacuum of 26 ins. was then applied for ½ hour, when the cylinder was opened and the blocks removed.

The treatment of the green blocks was made in exactly the same manner as described above, except that in no case did the temperature during the steaming exceed 242° F. The oil was applied under pressure for a total period of 3 hours 20 minutes, the pressure being increased by 5-lb. increments, as before, until at the end of 1 hour 50 lbs. was applied, at the end of 2 hours 100 lbs. was applied, and at the end of 3 hours 150 lbs. was applied and maintained until the end of the run.

In the first run the volume of the blocks being treated was 3.83 cu. ft., while in the second run the volume was 3.52 cu. ft.

Table 1 shows the weights of the blocks before treatment, after steaming and vacuum, and after the creosote treatment.

The absorption of preservatives in the four groups of blocks varied from 14.5 to 19.15 lbs. per cubic foot (Table 1). Allowance was made for changes in moisture content during treatment in computing these absorptions.

The changes in moisture content during treatment as shown in Table 1 are very interesting. The air-dry blocks gained in moisture while the green blocks lost, the difference being markedly greater in

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those blocks containing the greatest proportions of sapwood. The condensation recovered during the vacuum period amounted to 6.2% in the air-dry and 9.3% in the green blocks, (all moisture determinations are based on the oven-dry weight of the wood). It is evident, therefore, that the air-dry blocks absorbed 8.1% of moisture during

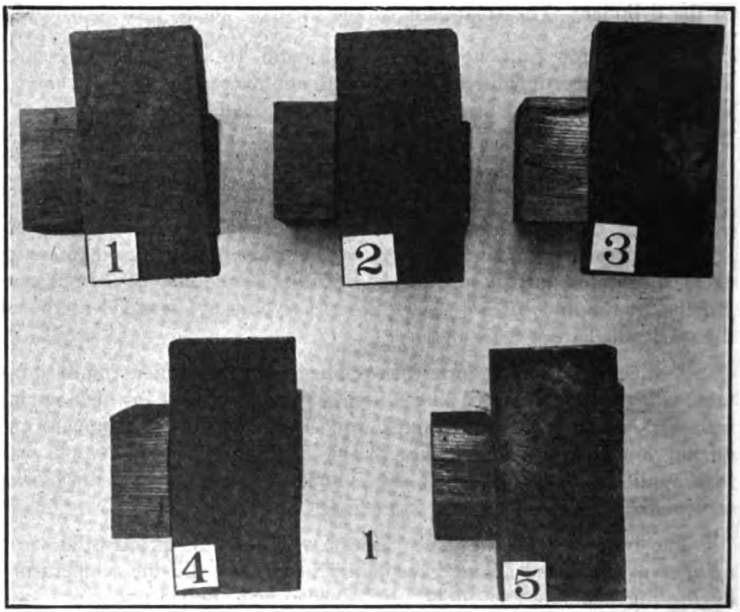

PLATE I.—Penetration of Creosote in Tested Paving Blocks.

1 A—3
2 B—1
3 Q—3 Green Heart.
4 R—3
5 S—3

the steaming period, and lost 6.2% during the vacuum, while the green blocks absorbed 7.6% during the steaming period and lost 9.3% while under the vacuum.

Plates 1 to 4 show the penetrations obtained in 19 of the 40 blocks tested in strength. The large piece in each case shows the transverse sections through the center. The small piece shows the other section of the same block in each case split through the pith, and hence the penetrations from the one end to the center of the block. The compression failure can be seen in some of the illustrations.

After treatment the treated blocks were placed with the natural ones and allowed to stand for 24 hours before testing. Table 2 gives the results of these tests.

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A summary of the tests shows that the treated green heart pieces gave average results 3.5% below the corresponding natural pieces, the treated green sap pieces about 1% higher than the corresponding natural pieces, the treated air-dry heart pieces 10% higher than the natural pieces, and treated air-dry sap pieces gave values 8.5% higher than the natural pieces.

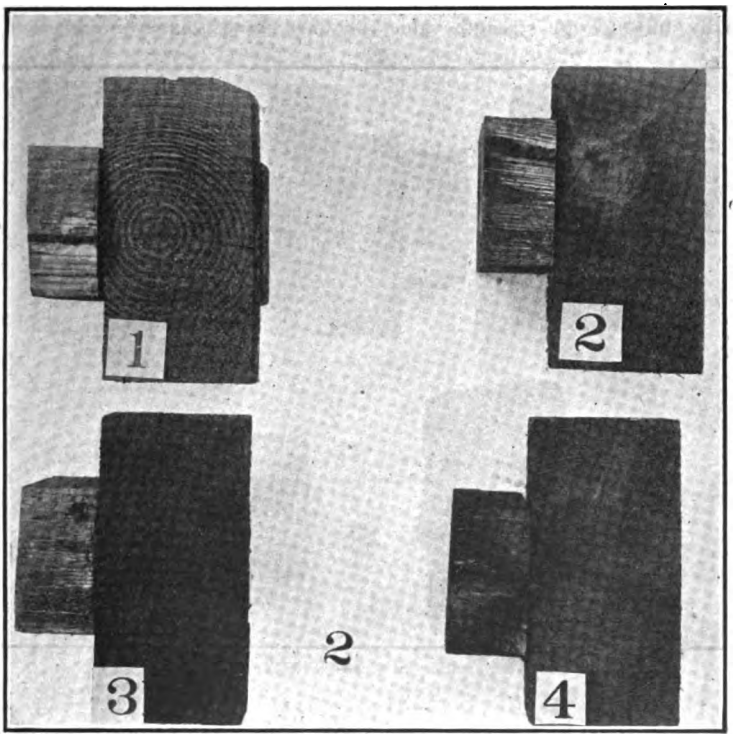

PLATE II.—Penetration of Creosote in Tested Paving Blocks.

1 C—1
2 D—3
3 O—3
4 P—3
} Green Sap.

In our judgment the above tests show no permanent differences in strength due to treatment, the differences being due to the changes in the internal stresses. In the air-dry material it is probable that casehardening introduced in drying was relieved, while in the green material drying stresses were introduced. If placed in service the blocks would normally absorb some moisture. Hence these stresses would probably all disappear and the blocks become of uniform strength.

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Variations in Test Data Due to Condition of Timber at Time of Test.

Much confusion will often arise by trying to compare data taken under different conditions. In order to emphasize the need of care in making such comparisons, and to show the extent to which strength values are dependant on different conditions of timber at time of test we have made a few simple experiments to illustrate these points.

The conditions, exclusive of quality or defects, which very materially influence the strength values obtained in tests, are differences in

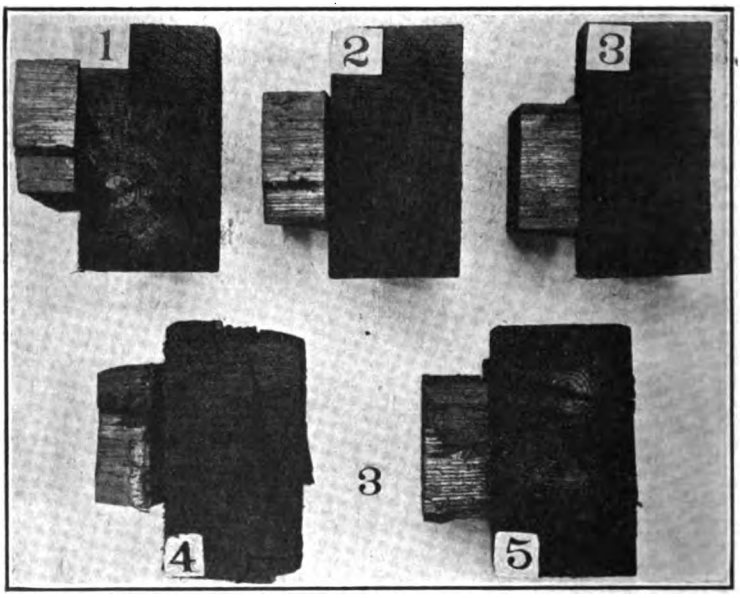

PLATE III.—Penetration of Creosote in Tested Paving Blocks.

1 H—1
2 I—3
3 J—3 } Air-Dry Heart.
4 K—1
5 L—3

moisture content, changes in temperature, and internal stresses caused by shrinkage or other factors. These various factors singularly may very materially influence the test values without any permanent change in the properties of the timber. The combined extreme effect may give an individual piece at least six times the strength in one condition that it has in another.

In one experiment two green paving blocks were placed in the oven and heated to 100° C. for about 5 hours. They were then cut in two, and one-half of each block was steamed for 30 minutes at 0

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pressure. These steamed pieces were then returned to the oven and dried to the same weight that they had previous to steaming. The four pieces were then placed side by side and allowed to stand until the next day, when they were tested. Both steamed pieces gave higher stresses than the unsteamed (5.5% and 13%). This was probably due to the relieving of stresses formed in them by rapid drying.

Some other experiments were run in which three green planks were cut into paving-block sizes. A few of the blocks were tested at once, being brought in directly from the outside. The others were placed in hot water, which was brought to about 95° C. for the last 2 hours. Four of the blocks, two from one plank and one from each of the others, were taken out of the water and tested immediately. The remaining blocks were taken out of the water and put in an oven maintained at about 80° C. For the next 3½ hours two blocks from

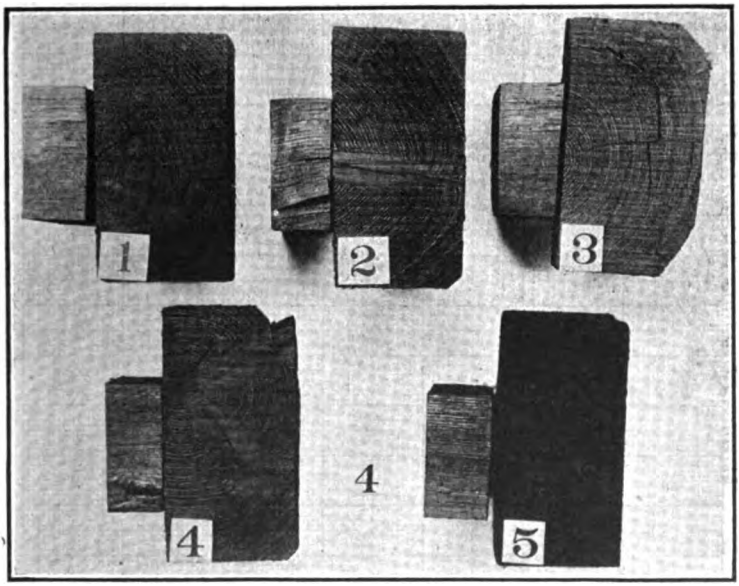

PLATE IV.—Penetration of Creosote in Tested Paving Blocks.

1 E—1
2 F—3
3 G—1 } Air-Dry Sap.
4 M—1
5 N—3

one plank and one from each of the others were tested at half-hour intervals; this exhausted the supply of blocks from the planks from which two blocks had been tested at a time. After this the tests on the blocks from the two remaining planks were run at irregular intervals.

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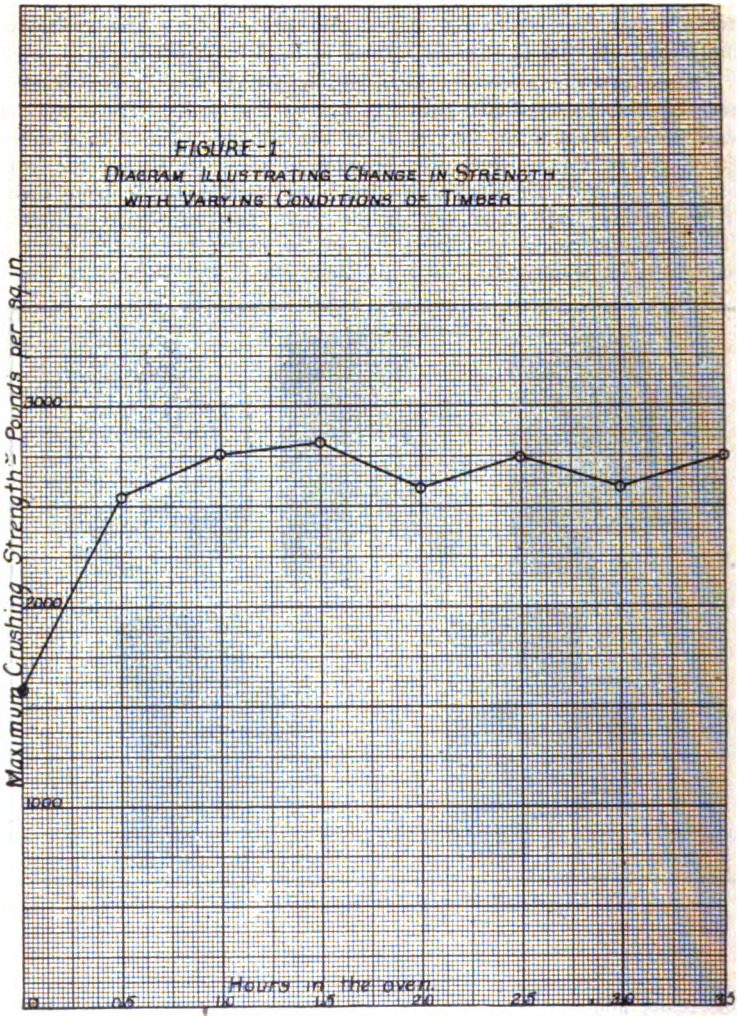

Fig. 1.

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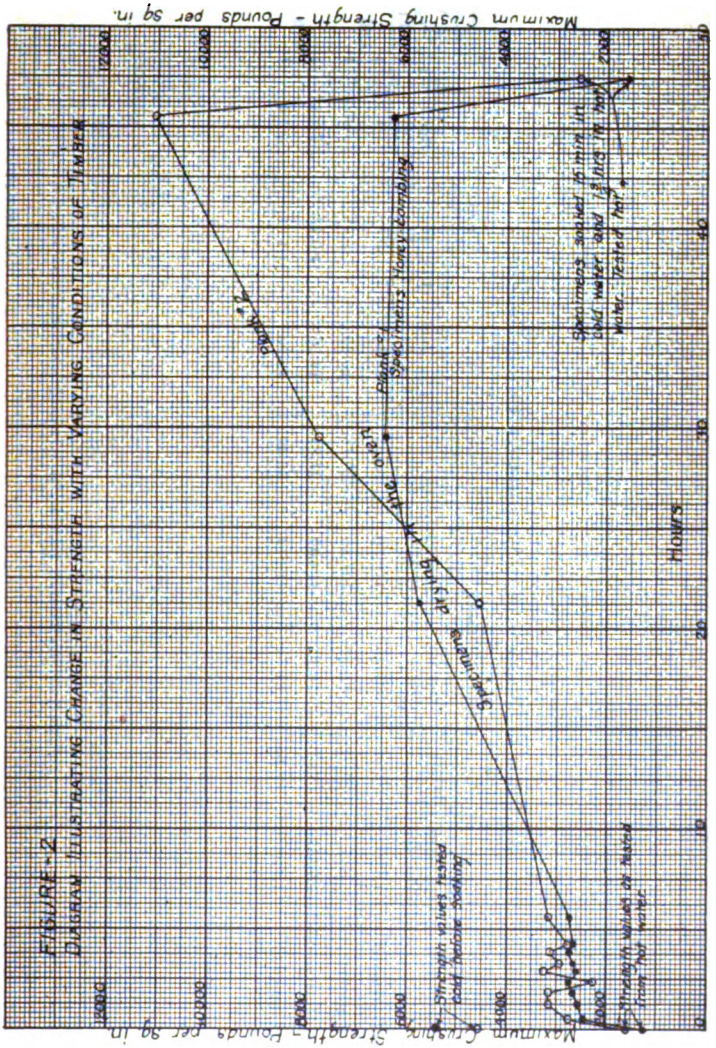
Maximum Crushing Strength - Pounds per sq in.
FIGURE 2
DIAGRAM ILLUSTRATING CHANGE IN STRENGTH WITH VARYING CONDITIONS OF TIMBER
Maximum Crushing Strength - Pounds per sq in.
HOURS

Fig. 2.

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TABLE 1.—WEIGHTS AND VOLUMES OF ENTIRE CHARGE.

Run No.	Kind of Wood	Volume Before Treatment. Cubic Feet.	Weight—Pounds.			Absorption of Creosote.		Change in Moisture.		Amount of Condensation During Vacuum.	
			Before Treatment.	After Steam and Vacuum.	After Creosote Treatment.	Lbs.	Lbs. Per Cu. Ft.	Lbs. Per Cu. Ft.	Per Cent.	Lbs. Per Cu. Ft.	Per Cent.
2	Green Heartwood	1.690	79.18	78.35	110.70	32.35	19.15	−0.49	−1.4	3.50	9.3
2	Green Sapwood	1.825	79.52	78.12	107.85	29.73	16.30	−0.79	−2.3		
1	Air-dry Heartwood	1.922	85.85	86.17	114.00	27.83	14.50	+0.17	+0.4	2.16	6.2
1	Air-dry Sapwood	1.910	79.34	81.74	112.14	30.40	15.90	+1.25	+3.4		

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TABLE 2.—STRENGTH TESTS OF PAVING BLOCKS.

NATURAL							TREATED				
Block No.	Sap. Per Cent.	Rings. Per Inch.	Summer-wood. Per Cent.	Moisture. Per Cent.	Specific Gravity. Oven-Dry.	Max. Crush. Strength. Lbs. Per Sq. In.	Block No.	Sap. Per Cent.	Rings. Per Inch.	Summer-wood. Per Cent.	Mx. Crush Strength. Lbs. Per Sq. In.
GREEN HEART.											
A—2	5	24	..	23.3	.544	4180	A—1	5	24	..	4030
A—4	5	24	..	24.1	.642	4230	A—3	5	24	..	4285
B—2	5	22	36	22.7	.550	5220	B—1	5	22	36	5140
B—2	5	22	36	23.3	.562	4650	B—3	5	22	36	4780
Q—2	5	8	31	19.6	.583	4780	Q—1	5	8	31	4710
Q—4	5	8	31	22.0	.550	4660	Q—3	5	8	31	4400
R—2	8	10	37	21.9	.610	4875	R—1	8	10	37	4390
R—4	8	10	37	21.7	.572	4760	R—3	8	10	37	4530
S—2	10	12	28	23.0	.525	4310	S—1	10	12	28	4250
S—4	10	12	28	22.8	.559	Cull	S—3	10	12	28	4180
Ave.	6.6	15.2	33.5	22.4	.570	4629	Ave.	6.6	15.2	33.5	4469
GREEN SAP.											
C—2	65	6	20	31.4	.502	3790	C—1	65	6	20	4120
C—4	65	6	20	32.6	.478	3660	C—3	65	6	20	4250
C—18	65	7	23	27.3	.494	3740	C—17	65	7	23	3935
D—2	40	13	36	27.1	.605	4500	D—1	40	13	36	4750
D—4	40	13	36	27.4	.582	4540	D—3	40	13	36	4690
D—20	40	13	41	22.5	.609	4330	D—21	40	13	41	4240
O—2	30	26	..	21.8	.583	4280	O—1	30	26	..	4130
O—4	30	26	..	24.1	.533	4580	O—3	30	26	..	4380
P—2	40	15	40	24.1	.531	4710	P—1	40	15	40	4275
P—4	40	15	40	24.6	.518	4610	P—3	40	15	40	4440
Ave.	45.4	14	32	26.3	.543	4274	Ave.	45.4	14	32	4321

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TABLE 2 Continued.—STRENGTH TESTS OF PAVING BLOCKS.

NATURAL							TREATED				
Block No.	Sap. Per Cent.	Rings. Per Inch.	Summer-wood. Per Cent.	Moisture. Per Cent.	Specific Gravity. Oven-Dry.	Max. Crush. Strength. Lbs. Per Sq. In.	Block No.	Sap. Per Cent.	Rings. Per Inch.	Summer-wood. Per Cent.	Mx. Crush Strength. Lbs. Per Sq. In.
AIR-DRY HEART.											
H—2	5	10	36	16.6	.705	5880	H—1	5	10	36	6970
H—4	5	10	36	17.9	.656	6540	H—3	5	10	36	6840
I—2	10	15	42	14.9	.647	5980	I—1	10	15	42	7330
I—4	10	15	42	17.0	.578	6400	I—3	10	15	42	6180
J—2	15	10	35	15.1	.579	5890	J—1	15	10	35	6400
J—4	15	10	35	16.6	.570	5880	J—3	15	10	35	6515
K—2	10	13	36	16.5	.592	6600	K—1	10	13	36	7260
K—4	10	13	36	18.5	.582	5790	K—3	10	13	36	6740
L—2	5	9	39	17.3	.687	6390	L—1	5	9	39	6970
L—4	5	9	39	19.0	.703	6210	L—3	5	9	39	6720
Ave.	9	11.4	37.6	16.9	.630	6156	Ave.	9	11.4	37.6	6792
AIR-DRY SAP.											
E—2	50	14	33	18.8	.589	5490	E—1	50	14	33	7325
E—4	50	14	33	18.7	.579	6080	E—3	50	14	33	7240
F—2	50	11	35	14.5	.680	5460	F—1	50	11	35	Cull
F—4	50	11	35	16.5	.600	5910	F—3	50	11	35	6700
G—2	60	13	33	16.1	.503	6060	G—1	60	13	33	6250
G—4	60	13	33	15.5	.519	6000	G—3	60	13	33	5660
N—2	50	11	44	19.3	.622	5840	N—1	50	11	44	6300
N—4	50	11	44	19.7	.630	5480	N—3	50	11	44	6420
M—2	45	12	33	15.9	.567	6200	M—1	45	12	33	6130
M—4	45	12	33	17.3	.560	5740	M—3	45	12	33	4920
Ave.	51	12.2	35.6	17.2	.585	5826	Ave.	51	12.2	35.6	6327

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Fig. 1 shows the average results obtained during the first 3½ hours. This curve shows a very rapid rise in strength for the first half hour in the oven, a smaller increase the second half hour, and after 1½ hours the values become irregular and in general lower. These strength changes are probably due in the greater part to changes in temperature, and to a less degree to changes in moisture and internal stresses.

While the oven was at practically the same temperature as the water the rapid evaporation of the moisture at the surface of the block would very materially lower the temperature of the interior of the block, also the drying of the ends would tend to increase the strength slightly.

After about 1½ hours the evaporation became so slow that the block began to heat up again, and the surface drying had probably caused some internal stresses. These factors combined caused the drop in the curve in this figure.

In Fig. 2 it will be seen that after about 6 hours, the blocks had again started to increase in strength, due to the loss of moisture, which counterbalanced the effect of high temperature and internal stresses. After this time the blocks increased in strength quite rapidly with loss of moisture for about 30 hours when the blocks from plank (1) began to lose, due to casehardening and honeycombing. At the end of 46 hours the block from plank (2) showed stresses more than double those of the original cold, and nearly seven times the stresses obtained from the blocks when taken from hot water. Blocks from piece (1) showed strength values five times those of the block taken from the hot water.

One block from each plank was then taken from the oven and placed in cold water for 15 minutes, the water was then heated to about 95° C., and held for 1¾ hours. Tests made at the end of this time showed stresses slightly less than one-fourth of those of the dry hot pieces tested 2 hours previously.

These results illustrate the need for caution in drawing conclusions from the results of strength tests on wood unless the conditions of test are accurately known and kept under close control. They also illustrate the possibility of drawing erroneous and misleading conclusions from tests where the full conditions under which they are made are not given.

After reading the first full paragraph of the report, Mr. Teesdale said:

MR. C. H. TEESDALE: There was a good deal of discussion during the year as to the possible effect of the treatment required by these specifications on the strength of the wood. In order to settle this

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some tests were made on the strength of the treated blocks, and the results of these tests are given in the Appendix to our report. Both green and air-seasoned blocks were tested. Each of these groups was divided into blocks containing a considerable amount of sapwood and others which were principally heartwood, so that we had the following four groups of blocks: air-dried sapwood, air-dried heartwood, green sapwood and green heartwood. These were treated as provided by the specifications, using the maximum limits, both as to temperature and time, and obtaining roughly about 16 lbs. of preservative per cubic foot. For each treated block an untreated block was selected and tested, the selection being made so that the treated and untreated blocks had the same original strength.

A summary of the tests shows the treated green heart pieces gave average results 3½% below the corresponding natural pieces, the treated green sap pieces about 1 per cent higher than the corresponding natural pieces, the treated air-dry heart pieces ten pr cent higher than the natural pieces, and treated air-dry sap pieces gave values 8½% higher than the natural pieces. It is rather surprising that the blocks after they were steamed and given this treatment showed on the average higher strength values than the untreated blocks with which they were very carefully matched. In order to explain that some additional tests were made to show the conditions which are liable to influence strength.

(Mr. Teesdale then read the first and second paragraphs on page 462 of the Appendix.)

MR. C. H. TEESDALE: That, by the way, is a condition which can be made to exist in the same piece of wood by testing it under different conditions. It might be possible to bring the two pieces back to practically the same strength. This is further illustrated in a number of other tests which are described in the Appendix. The main point is that these results illustrate the need for caution in drawing conclusions from the results of strength tests on wood, unless the conditions of tests are accurately known and kept under close control. They also illustrate the possibility of drawing erroneous and misleading conclusions from tests where the full conditions under which they are made are not given.

Returning to the reason why the treated blocks were stronger than the untreated ones, the explanation is that internal stresses were set up in the wood during seasoning. These stresses were caused by unequal shrinkage, the outer fibers shrinking more because of more rapid drying. When the treated blocks were placed in the cylinder and steamed, the outer fibers reabsorbed moisture and relieved the internal stresses. Hence these blocks became a little bit stronger than they

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were while they still retained those stresses. Actually, the untreated and the treated blocks were of the same strength when tested under exactly similar conditions, and we may safely conclude that the treatment recommended by the Committee has no effect on the strength of the wood when it is properly carried out.

MR. M. K. TRUMBULL: That applies to the wood blocks?

MR. C. H. TEESDALE: Yes, sir, treated under these specifications. I wish to call your attention again to the work of this joint committee which met at Brooklyn. The results of that meeting were very far-reaching. They honored the American Wood-Preservers' Association by accepting practically without change the report which was presented to you last year, and as a result of that meeting the American Society of Municipal Improvements has definitely adopted the specification, with very minor changes, the American Society of Civil Engineers, a Committee of that Society has presented the report to the convention, and I understand that it probably will be adopted next year. Quite a number of cities have adopted the specifications and are now using them, and several hundred thousand square yards of blocks have been treated.

On account of the adoption of these specifications which were developed in this Association by other associations and by various cities which are now using them, I feel very strongly that the American Wood-Preservers' Association should adopt them practically without change. Mr. Chairman, I would like to move that the specifications as printed in italics and as corrected, together with the accompanying footnotes, be adopted by the Association and inserted in the MANUAL as recommended practice, and that the rest of the report which you have in your hands, and which is not printed in italics, be accepted as information.

MR. M. K. TRUMBULL: Mr. President, I second that motion, and wish to add that we should thank the Committee for its very excellent work.

MR. W. H. GRADY: Are we going to have the opportunity to discuss this?

THE PRESIDENT: Yes, sir.

MR. A. L. KUEHN: I should like to ask Mr. Teesdale to tell us why the Committee adopted the steaming of air-seasoned timber.

MR. C. H. TEESDALE: The Committee desires to steam air-seasoned timber in order to prevent or reduce bleeding troubles. Does that answer your question?

MR. A. L. KUEHN: I have some discussion on it. The expansion trouble explained is due to the additional moisture which is put

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in the wood. I have made some calculations on Mr. Newlin's supplementary report which show up a little more clearly what happens in those steaming tests. By the way, I would like to call your attention to the actual moisture content as reported by Mr. Newlin's in all cases as that within the range of the air-dry timber. For example, the material which is called green heart contained only 22.4% moisture. I think that would be easily classed as air-dry material. The sap contains 26.3%. That also I think would reasonably come within the classification of air-dry material, so that these ties are not all green sap and green heart, as most of us get them, particularly close to the mill, so that any conclusion based on that, as far as the effects of green heart and green sap are concerned would be erroneous.

Now it is possible to calculate from these tests what happens. Take that first test. The oven-dry weight is 38.3. These are calculations that I made from those and they are continued in another way in this thing, but they show up clearly the point I am making. The oven-dry weight is 38.3, and this weight is per cubic foot. The weight as treated, or as put in the cylinder as received, was 46.9, moisture content 22.4.

Now from the statement of condensation obtained the weight of that wood per cubic foot in the half of that charge, which was green heart, must have been 49.4 at the end of the 4 hours' steaming, and moisture content of 30.4%. It finished, of course, going down to 46.4 lbs. per cubic foot, and moisture content of 21.1. The other three have similar conclusions. At the end of the steaming period the second item, or the so-called green sap, contained 34.2% moisture, the next one 22.8, the next one 27.1; in other words, after you steamed it for 4 hours you had material which would come pretty close to being called air-dry material. You are putting hundreds of thousands of yards of blocks, which we are calling air-dry, and which would come under the classification so generally understood, which would be as wet as this material was after steaming. In other words, steaming material for 4 hours at the pressure shown put but very little moisture in the wood.

Now bringing out this steaming business, I have before me a calculation— I think this is vital and it gives a little clearer understanding I think of what goes on in the steaming of wood. I have never seen this made, but this is according to the law of physics. I have a calculation here based on these assumptions. I have taken the material containing a certain percentage of moisture. I have subjected that to steam and raised the temperature of the wood as well as the content of the moisture to that of the temperature of the steam. Now we place a vacuum then to reduce that moisture. That moisture is reduced by evaporation, and we have to supply enough heat to overcome the

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heat of vaporization. We pull down by this vacuum the temperature of boiling the water to a certain line. Therefore the heat available for this evaporation is the heat in the wood, and the water in the wood above that line. Applying that heat to the water in the wood we can only make a very slight change in the moisture theoretically possible. I am taking a high case here, 70% of the moisture in the wood. Applying the heat available to that reduction we reduce the temperature in that wood to about 75%. That is all you can do unless you supply outside heat somewhere. That cylinder has a vacuum in it. Therefore, the only heat you can get is through radiation in the coils. That is not much more than the radiation from the cylinder. So that the changes which we can make in temperature by this steaming process are away within the ranges of the difference in moisture in the timber as we receive it. This is theoretically correct, and you cannot quite approach that practice. This is the idea. So that I think something else takes place as the expansion is stopped in that way.

I am in doubt whether it does really effect the expansion in the street, particularly of course if the blocks lay around in the street six or eight weeks or a couple of months, that is the small change in moisture which is produced by this steaming. I am talking about air-seasoned material. Now, it will not have a material effect on the expansion feature, and it is a waste of time. Now, the bleeding, of course, we are all interested in that. Of course, we have all been looking at wood-block pavements, our own as well as the others, and I for one—of course, there may be many here that have greater observations than I have had—do not feel satisfied that I have information enough to say that the steaming of this air-dry material will prevent the bleeding. I made the statement at the last meeting to Mr. Teesdale on which he made his report. He made a report that a few blocks had been treated in this way and they showed no signs of steaming. I made the criticism that the bases of those conclusions were too small. Now I think that is an honest criticism, particularly in view of what Mr. Teesdale said as to the variability of the wood. You would have to have a great number of experiments.

In that connection the point I am trying to make—I do not want to appear as making destructive criticisms, I do not think we want that kind of criticisms, but I am going to offer some directly which I think will be constructive.

For example, Mr. Newlin's paper—now I have a high regard for Mr. Newlin's technical ability. He has been at it for a long time. I think he was hurried. Somebody brought this point up and said, now make some tests. He did the best he could in the time. His conclusions are based—well, as I heard one man say, on a hatful of blocks. That is a little bit strong, but nevertheless it shows the criticism you

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lay yourself open to when you conclude from three or four yards of blocks. I guess it is only about two yards of blocks. I just happen to have in my hand here Forest Circular No. 30. I guess it is classic enough so that everyone knows it, and it certainly covers a very much larger range of heads than is covered in this one. It proves that steam does materially affect the strength of blocks, particularly the compression endwise the grain.

I would like to sum up by saying that I would like to have the Committee make it possible that if a man wants to treat a dry material he can. He is not prevented from doing so and not considered as bad practice in the light of this Association, and if I can offer some changes in that specification a little later, I will be glad to do so.

MR. C. H. TEESDALE: I would like to ask Mr. Kuehn what is the moisture content of green heart yellow pine?

MR. A. L. KUEHN: Well, the lumberman generally figures on 4500 lbs. to the 1000 ft., that is 4½ lbs. a board foot.

MR. C. H. TEESDALE: I can state that the moisture content, both of green heart yellow pine and green Douglas fir is about 35% when first cut.

MR. A. L. KUEHN: I have weighed lumber that weighed considerably more than that, 4½ lbs. to the board foot.

MR. C. H. TEESDALE: This timber was furnished by Mr. Card, of the Central Creosoting Co. (formerly Chicago Creosoting Co.), was taken right off the car as it arrived from the mill, and the blocks were tested immediately. Now as to your criticism on the small number of blocks. They were very carefully matched and each pair of blocks was taken from a different stick, so that a variety of timber was represented. When strength tests are made on matched blocks you can get much more reliable results than you can on a very much larger number if they are not matched; in fact, one cannot draw a definite conclusion even from a very large number of tests on treated wood, even when the exact conditions under which the tests are made are known, unless the specimens are matched with each other.

MR. W. H. FULWEILER: Mr. Chairman, I just want to call your attention to one point that I think would make for greater uniformity. In the reports of the various committees on specifications they practically all use the Centigrade temperatures. I note that in the specification for the coal-tar pitch the Fahrenheit temperatures are used. I feel that it would make the technical work of the Association more uniform if we would use the same temperatures, Centigrade, throughout all our technical specifications. The temperatures used were apparently originally Centigrade and have been changed over to Fahrenheit. They use 77° F. and that is 25° C., and they use 670° F. and that is 355° C.

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MR. C. H. TEESDALE: That is satisfactory to the Committee.

MR. WALTER BUEHLER: There are certain practical considerations that must be taken into account when we treat timber for paving blocks. Timber, air-seasoned, is contracted. The subsequent oil treatment does not expand it, and when the block is made from that air-seasoned timber, and laid in the street the first rainstorm will expand it. One of the objects of steaming air-seasoned timber is to bring it back to its expanded condition, or its natural size.

We all know that we can treat blocks with 20 lbs. of oil to the cubic foot, ship them out on the street, stack them along the curb for two weeks or three weeks and allow them to season there, put them in the street, and the first rain will expand them. I know of one case where blocks were shipped to a certain street in Chicago, and for some reason or other the street could not be completed and the blocks were stored under cover for a period of about 8 months. The street was then paved with these blocks, and about two weeks after in a rainstorm the blocks expanded. They were absolutely new blocks, had been under traffic for only two weeks, they expanded in some cases as high as 2 ft. off of the concrete foundation. Now you would have exactly the same condition if you would season your timber before treatment, then treat it and put it in the street.

As to the influence on bleeding, we treat paving blocks with 16 to 20 lbs. of oil to the cubic foot. The block is a small section. There is from 75 to 80% heart, or from 20 to 25% sap on a great many of the blocks. Now take a condition where this block is thoroughly air-seasoned, you put it in the retort and apply pressure. We all know that we can put 16 lbs. of oil in very rapidly under that condition. Where does it go? It goes into the sap because it naturally follows the line of least resistance, and the sap will take it more easily than the heart, and instead of getting an average of 16 lbs. uniformly distributed through the sap and heart, you are getting most of that 16 lbs. in the sap. You are treating a part of the block. This past summer I inspected some blocks in a certain city in Illinois that were treated that way. I cut open a great many of the blocks and in every case the heartwood had absolutely no oil and the sapwood was absolutely loaded. There an investigation showed that this timber had been in the yard about 8 months and had received no preliminary steaming before treatment. We have to realize that we have a condition in the treating of paving blocks that is different than the treatment of ties or timber. I would not stand here and say you should steam air-seasoned timber or ties before treatment. It is an entirely different problem. We recommend the steaming of air-seasoned timber for paving blocks to meet a certain condition.

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Now take these blocks with the oil in the sapwood. Allow blocks to expand and you get a squeezing action which will squeeze some oil out of the sapwood. I do not claim that that is the whole reason for bleeding, but I do claim that it is a contributing factor. If we steam the seasoned timber we place that timber in condition so when we apply pressure we get a more uniform distribution of oil in the block, and I believe that is a very important consideration.

I might say in regard to these tests, there were other tests made at Purdue University. The tests were not completed in time to print, but they will be printed in the PROCEEDINGS. The tests at Purdue University were conducted by Dr. Hatt. They were made on blocks treated by the Chicago (Central) Creosoting Co. at Terre Haute, and they were divided into three groups: Treated blocks and their control tested immediately upon arrival at the University, treated blocks and their control tested after seasoning, and treated blocks and their control put in a box and covered with wet sawdust and kept in moist condition about 2 months, so that we had these three conditions: the dried block after treatment, the block that was tested immediately on arrival at the University, and the block that had been subjected to moisture. The results of these tests bear out the tests made at Madison, that there was no deterioration or reduction in strength due to the steaming. Now steaming will affect the strength of the block or will affect the strength of the timber if you carry the temperature or the pressure beyond proper limits.

We all know of the tests that were made at St. Louis during the World's Fair by Dr. von Schrenk and Professor Hatt, to determine the effect of steaming on the strength of timber. We know it was found in those tests that there were certain limits above which the strength would be affected by steaming. The tests made by the Committee show that within the limits set by this specification there is no decrease in strength.

MR. A. L. KUEHN: Mr. Chairman, the Committee makes a suggestion and recommendation in the latter part of this report that the blocks be wetted just prior to laying. I think that is one of the most important things in connection with getting successful results. Now no matter what you did with those blocks in the treatment, as far as the moisture content is concerned, Mr. Buehler or no one else that I think has studied the problem, would say that if these blocks had been laying on the street 8 or 9 months, or half of that, that under those conditions they should be laid in that street without wetting. Put the rain on them as you are laying them, and you have got something. If you change the moisture content of this wood as I have just shown by Mr. Newlin's report here, 2, 3 or 4%, and then let the blocks lay on the

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street a few weeks, you have wasted all your energy. Now there is something to this point.

Everyone who is trying to get in wood pavements say it costs too much. We are trying to reach out in the farther districts in the cities for wood blocks where we are competing with other pavements which are much cheaper. Do not do anything that is going to increase the cost of our pavements, particularly if it is doubtful that it will improve it.

Now bleeding; I have grave doubts if some of us are satisfied that we have the answer to the problem of bleeding. It appears that one of the first jobs in wood blocks I had to do with was made and treated under my direction, and it was air-seasoned timber. It was an accident. That block was laid and naturally I watched it. I saw them laying it. It was laid in front of a hotel where I had to lunch. I saw it nearly every day. That block did not bleed a drop and I know that many of us have similar instances. Now, again, there will be an example of block that was treated air-dry and which bled. I think we are in that condition right today. I do not believe that this is the answer to bleeding, and I do not think it is proved. I think the Committee should furnish us a table before we accept some of these things, similar to the report Mr. Williams had here this morning, to convince some of us. I think they want this.

Penetration: Where do you put most of the moisture when you steam the blocks? Just where Mr. Buehler says you put most of the oil, in the sapwood. Unfortunately, treating plants are subject to more or less variation. We hope that most of the time we are as fortunate as Mr. Newlin in getting the moisture back to where we started. If you do not, it is in the sapwood.

All of us know that the less water we have to contend with in treating timber the more nearly we will be satisfied with the penetration we get. Water is our enemy to good results in treating, as Mr. Rex showed us yesterday. If most of that water is in the sapwood and accidentally you do not get enough of it out, where have you got your poor penetration? Not only in the heartwood, it may be bad in the heartwood, but in the sap. Then, what have you got? You have got Charleston and St. Louis, as Dr. von Schrenk described to us last year.

MR. J. C. WILLIAMS: Mr. Chairman, I would like to ask for information of the Committee, if it knows whether this applied moisture actually goes into the wood fiber or only into the air-cells? It seems to me if the moisture only goes into the cells that it does not accomplish anything in the way of swelling up the block. You burn your fuel, produce your steam, place it in the cells of the wood, and then you take it out right away and you have incurred considerable

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expense in doing all this, but you have not accomplished anything because it takes moisture retained in the wood fiber itself to swell the blocks.

MR. WALTER BUEHLER: Mr. Chairman, it must go into the fiber for this reason, that we know moisture in the cell structure has absolutely no effect on the expansion or contraction of timber. It is only when the fiber saturation point of timber is reached that you are are changing the percentage of moisture in the fiber, that you change its size, either contracting or expanding it. Air-seasoned timber steamed will expand, so that you can only draw one conclusion, that it goes in the fiber, probably also into the cell structure, but it goes into the fiber to the extent that it will expand it back to the original size.

MR. H. G. JENNISON: I just want to say that I agree with Mr. Kuehn on almost everything he said in reference to the treatment of air-seasoned timber, and especially for paving blocks. Now if you could lay those blocks on the street just as your specification calls for, you would undoubtedly get results, but if you treat green timber at the plant, that is no insurance that those blocks are going to be expanded to the limit when they are laid in the street; as a matter of fact, you cannot tell when those blocks are to be laid. I have known blocks to be delivered in Detroit in the fall of the year and not laid until the next spring. I do not believe that the treating of green timber is going to stop buckling. That has not been my experience in laying a great many pavements around the country.

MR. C. H. TEESDALE: Mr. President, I think every one of these points is answered in the specification. For instance, the question of the buckling of steamed, air-seasoned blocks is handled on page 456 under section 5.

> The blocks shall preferably be laid in the street as soon as possible after being treated.

MR. E. B. FULKS: How much more do they cost?

MR. A. L. KUEHN: I think Mr. Teesdale has not brought out some of the practical points. After you have delivered the blocks on the street you have no control over when they are going to be laid. This paragraph says "perferably," which means nothing. They are going to be laid when conditions are such that they can be laid. Summing up what I have been saying, you let me treat air-dry material and then sprinkle them on the street before you lay them, and I will guarantee you will have no buckling and you will have better treated blocks than if you put some moisture in this sapwood.

MR. WALTER BUEHLER: Mr. Chairman, I would like to ask you this question. If you treat thoroughly air-seasoned yellow-pine blocks 75% heart with 16 lbs. of oil to the cubic foot, what, in your

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opinion, will be the distribution of the oil? What percentage of the oil will go into the sap, and what percentage will go into the heart? Do you consider it important that the heartwood be treated as well as the sap?

MR. A. L. KUEHN: I consider it more important that the sapwood be treated than the heartwood. I agree with what you said before, that the sap will take up a greater percentage of the oil. It will in your case if you steam it with this little additional moisture on a full per cent., but I do not want any condition that is going to jeopardize the solid penetration of sapwood to produce, I will say again, Charleston and St. Louis. I will give up something of the heartwood, but I will not give anything up on sap, as far as penetration goes.

MR. WALTER BUEHLER: I would like to say that if the provision in the specification in reference to pounds of pressure and time be followed, you will not jeopardize the treatment of sapwood. You will get good treatment.

MR. A. L. KUEHN: I think any of us can find an equal number of air-seasoned blocks that will show the same thing. I do not believe anyone wants to deny that. I do not know that we are getting anywhere. My idea of this thing is this: I am getting to the point that I want to be able to treat air-seasoned timber, I want to be able to do it and not be considered in bad order as far as the American Wood-Preservers' Association is concerned. To go on with these, I do not think destructive criticism is worth anything. Now if this read, "the lumber may be air-seasoned or green," then cut out, "but should preferably be treated within three months from the time."

THE PRESIDENT: We do not want to unnecessarily hurry things, but may I ask you to hurry as much as you can?

MR. A. L. KUEHN: That is what I am doing. Now I want to bring this to an end. The timber may be air-seasoned or green, and cut out the sentence, "but should preferably be treated within 3 months from the time it is sawed." Green timber and seasoned timber—do not cut this out now—green timber and seasoned timber shall not, however be treated together in the same charge. Blocks shall be treated in an air-tight cylinder with a preservative heretofore specified. Cut out, "in all cases thoroughly air-seasoned or green," and then go on, "they shall be subjected to live steam at a temperature between 200 and 240° F. for not less than 2 hours nor more than 4 hours, at the discretion of the treating plant operator, after which they shall be subjected to a vacuum of not less than 22 inches, held for at least one hour." Insert there, "for air-seasoned timber preliminary steaming may be omitted." Then add the sentence, "In case the preliminary steaming for air-seasoned timber is omitted, the pressure shall be car-

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ried up slowly until the prescribed preservative is absorbed." That latter, I think, is subject to a little more detail. I simply want to bring out the point. I move that this paragraph be modified as I have suggested.

MR. R. V. LOOK: I second the motion.

MR. C. H. TEESDALE: Mr. President, the Committee feels that those changes would jeopardize the specification, and practically ruin the work which has been done thus far through the joint committee, and it is very much opposed to the changes suggested. We do not approve of them.

MR. GEO. M. HUNT: Mr. Chairman, in order that we may all get clearly in mind the discussion, I would like to summarize a few of the points. We are going to vote on this amendment, and we want to vote with a thorough understanding of what has been said. The discussion is centered on four different points. Of these four different results that may be accomplished by steaming, one is the effect on the moisture content. Mr. Kuehn says that you get practically no change in moisture content, and if you do get a change it is all eliminated by subsequent seasoning in the street. Well, assuming that we get no change and it is eliminated by seasoning in the street, the Committee has covered that by providing for sprinkling the blocks as they are laid. That is what Mr. Kuehn suggests to prevent expansion. Therefore, Mr. Kuehn and the Committee agree upon that, but here is another thing which steaming does, that is not shown by simple moisture percentages before and after treament, and that is that we all know that the heartwood of longleaf pine and most other woods will take up creosote and will take up water with more difficulty than the sap will.

When you steam dry paving blocks your sapwood will take up water very much more rapidly than the heartwood. Your final condition of the block therefore, is that your sapwood contains more water and the heartwood perhaps a little bit less than if they were not steamed. You get a distribution of moisture which will give you better results in the end. You get a distribution of moisture rather than a change in net moisture content. The second point is bleeding. What effect has steaming on bleeding? Mr. Kuehn says it has no effect, but he does not produce any data to prove it. The Committee says it does not have an effect and produces data to prove it.

The third point is the effect on strength. Mr. Kuehn says that steaming does affect the strength. He refers to Forest Circular 39 as his authority. If you will examine that circular, I think you will find that all those experiments were made on ties and on half ties, and that the effect on strength was obtained at steam pressures above 20

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lbs., while the Committee is talking about steam pressures below 20 lbs. Therefore, the data do not apply to the case under consideration.

The Committee quotes two different series of tests in support of its contention that there is no effect on the strength. It might have quoted other tests. For instance, Department of Agriculture Bulletin 286 shows that steaming of southern yellow pine has practically no effect on strength, that is even in the form of large timber, and it is definitely proven that steaming of smaller pieces of wood has less effect on the strength than with larger pieces.

The fourth, and the one that appeals to me as the most important consideration of all, is the effect of steaming on penetration. The distribution of oil has been touched on. Tests have shown that you will get more oil in the heartwood and not such a great excess in the sapwood if you give your blocks a preliminary steaming. Dr. von Schrenk's pictures of last year were referred to, and in those pictures he showed, as I remember it, some blocks in which the decay was in the heartwood and not in the sap, and, as I remember it, he attributed that to the fact that the sapwood took all the oil and the heartwood took none. He also showed some other pictures in which the sapwood was decayed and the heartwood was not, but he said those were green blocks in which there was an excess of moisture; an excess of moisture, not just simply some moisture, and the sap did not take treatment properly. You may get decay in the heart or you may get decay in the sap, depending upon which has the better treatment.

MR. A. L. KUEHN: Mr. Chairman, pardon me for taking the time, but I believe I can answer Mr. Hunt. Mr. Hunt stated, and I believe it is claimed that this variation in the water is in the sap. I think you will recognize that. That is just the point. With the accidents in the practical operation of a treating plant which do occur in the best plants, you are jeopardizing the penetration of the sap by this extra moisture in the sap. Mr. Hunt said I produced no examples. I mentioned one and named the street, in front of the Great Northern Hotel in Chicago. I have some notes on that which I would be glad to supply. Strength: What Mr. Hunt stated about that circular is not quite in line with what this states. There are a lot of small pieces in this thing, and as far as affecting the strength is concerned, I will read here:

> Steamed for 4 hours at 20 lbs. showed compression strength parallel to the grain 79.1% of the natural.

That is seasoned loblolly pine. Now, on that point, if you do not accept this too literally, I was present when a certain lumberman asked the Bureau of Tests to make a certain set of tests of his particular material. His was better than anybody else's. The man from the

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Bureau of Tests answered him, "What do you want to prove?" I am simply stating that to show that. Take also Mr. Teesdale's statement, you can get variations of 600%. You need lots of tests to wipe out that variation and get the true answer.

MR. W. H. GRADY: Mr. President, I would like to answer the question Mr. Buehler asked about the penetration of heartwood in seasoned blocks. When you drop the oil on a charge of seasoned blocks, the end penetration, that is, the penetration on the cross-section which is parallel to the fiber, without any pressure whatever, the initial absorption we call it, will be sufficient to protect that heartwood, provided the sap is protected. The initial absorption alone will go into that heartwood sufficiently to protect that block, providing you protect the surrounding sap. As the preceding Committee was reading its report I saw something for the first time, which flashed up before me like a warning. It says, in Minneapolis:

> This pavement is failing through decay of the blocks as a result of insufficient penetration of the oil into the sapwood.

Are we going to rush head-on, with a red flag up ahead of us, like that? You state you put the water in the sapwood to keep the oil out. Now you propose to fill the sap up with water and we want the oil to go in there.

MR. WALTER BUEHLER: I would like to answer that by saying this. I have inspected a great many thousands of yards of paving in a great many cities. I have treated a great many paving blocks. I have watched this proposition for about 14 years, and I say as a positive fact that in every case where the timber was seasoned before it was treated there has been trouble from expansion.

Mr. Ericson, in Chicago in 1911, made a very detailed report of all the streets laid in Chicago up to that time, and in this report he showed the trouble due to bleeding and the trouble due to expansion, and a very significant fact stands out in that report. That one company that had made it a practice to treat practically from car to plant had the least trouble due to expansion, that one company that had made it the practice to keep from a million to a million and a half feet of lumber in its yards had the most trouble due to expansion, and I claim this was due absolutely to the seasoning of the timber before treatment.

MR. A. L. KUEHN: I would like to ask Mr. Buehler if it is not a positive fact that it has not been the practice to wet the blocks as is recommended by this Committee?

MR. WALTER BUEHLER: That it has not been the practice?

MR. A. L. KUEHN: That it has not been the practice; that the opposite has been the practice.

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MR. WALTER BUEHLER: You mean before treatment, or on the street?

MR. A. L. KUEHN: On the street.

MR. WALTER BUEHLER: I would not say that. I say it has been the practice in a great many cities. You could not answer that by yes or no.

MR. A. L. KUEHN: Did they in Chicago?

MR. WALTER BUEHLER: Some cities have followed that practice, and other cities have not.

MR. E. B. FULKS: Who took this Ericson report in Chicago?

MR. C. H. TEESDALE: I would like to point out again that if this specification is followed the points which seem to be bothering you gentlemen will not come up. Under inspection it provides that the blocks shall be treated through and through. The blocks are not to be accepted if they are not thoroughly penetrated. A definite procedure is provided for obtaining that result. I want to point out also that the remarks being made here have not been supported by data, whereas the work of the Committee is all based upon data which has been published.

THE PRESIDENT: Gentlemen, I believe we have given about all the time we can give to this discussion, and it has been pretty largely confined to a few. I have tried to give everyone a fair chance, but the discussion has not been very generally participated in. Unless there is someone that has something particular to say at this time, I think we will have to put the amendment to the original motion. However, if there is somebody that wishes to cover some point that has not already been covered or touched upon, I will be glad to give you a moment's time for the presentation of your remarks.

MR. L. B. MOSES: I do not wish to undertake any discussion of the question at all further than to say it seems to me that the specification as recommended by the Committee will certainly place more of an obligation on the manufacturers to follow this material through and see that it is properly handled after treatment than would be the case if the amendment were adopted. For that reason, above everything else, I should be in favor of the Committee's report.

MR. W. H. GRADY: Mr. President, I think every time you go to a man with a proposition about wood-block pavement, the first thing he says to you is "Too expensive." The most expensive way of putting water in blocks is to steam them and prolong the operation up to 10 or 12 hours. You can effectively treat seasoned blocks in 3 or 4 hours. Now it would be a good deal cheaper to put the water in on the street with a hose than to burn up the coal in the boiler. It is agreed by all

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that the water put in by steaming will not remain in the blocks unless they are laid in the street promptly. As these are seldom laid promptly why pay freight on water? Now as to treating green blocks. Most all the southern pine mills try to at least partly season block lumber for northern shipments in order to save freight. Sometimes even kiln-dry it. Think of the extra cost of blocks caused by freight on green lumber, say to Detroit, Chicago, Minneapolis or New York, from the pine mills near the Gulf of Mexico.

MR. WALTER BUEHLER: Mr. President, I do not want to unnecessarily prolong this discussion, but the question of cost does not enter into the question of steaming to the extent which it has been intimated it would. The plant cost is a very small percentage of the cost of the finished pavement, and I doubt whether the cost would be affected a fraction of 1%.

THE PRESIDENT: Gentlemen, we have the motion before us to adopt the Committee's specification, and that has been amended to change certain sentences, as read by Mr. Kuehn. Before I put this amendment I just want to put the two propositions before you, as I see it so far as this Association is concerned, and I say this as your President in trying to push forward the best interests of the Association. We have on the one hand here a report in which our chosen Committee has prepared and given a year of study and time in preparing it, and that they, or representatives of this Association, have met with representatives of other associations, and they have practically taken this report and agreed to recommend it to their associations, and ask them to adopt it. On the other hand, we, as an Association, do not want to adopt standards which are not right, or as nearly right as we can get them at this time. I do feel that we should adopt specifications, and we want them as nearly right as possible.

I ask all of you to bear these points in mind, and those which have been brought out by the discussion, in voting on this question, and I will now put the amendment to the report as read by Mr. Kuehn. All those who are in favor of the amendment will please signify it by saying "aye"; all those opposed, "no." I will ask you to take a standing vote on it. All those who are in favor will please rise to your feet. All those that are opposed please rise to your feet. The motion is lost.

Now we will go back to the original motion to accept these specifications and adopt them as recommended practice, to be published in the MANUAL. All those in favor of the motion will please signify it by saying "aye"; those opposed, "no." The motion is carried. That includes the acceptance of the remainder of the report as information.

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MR. C. H. TEESDALE: Under recommendations for future work, I had pointed out to me the question of preparing specifications for interior wood-block flooring, and the Committee has no objection to including that in the recommendations for next year.

MR. RICHARD V. LOOK: Mr. President, we have a good deal of very valuable information covering the use of wood blocks for outside work, but we have not a great deal covering the use of the same blocks indoors, and I would suggest that the Committee for next year be instructed, and I put it in the form of a motion, if I am in order, that it be instructed next year to bring in recommendations covering blocks for indoor work, including a recommendation as to a method to prevent shrinkage as much as possible, after having been laid in the floor, and a recommendation covering the number of pounds per cubic foot that they would recommend as being best practice, and further a recommendation that when blocks are sold for interior work the number of pounds per cubic foot be specified, so that the purchaser may know what he may expect to get.

THE PRESIDENT: Is there a second to this motion?

MR. A. L. KUEHN: I second the motion.

THE PRESIDENT: You have heard the motion as a suggestion for the work of next year's Committee. I believe that the suggestions are the result of a lack of information which has been experienced by men furnishing interior blocks. All of those in favor of the motion signify it by saying "aye"; all those opposed, say "no." The motion is carried.

MR. H. I. GOLDSTEIN: I would like to make a recommendation for the Committee to look up and suggest means of testing the amount of oil in wood blocks by chemical means.

Most of the men who are at the plants have long hours, men who employ them think they can stay 24 hours a day; that is, by questions they ask they seem to expect them to do it. Whether they can or not is a question. I know I cannot; therefore I would like to have the Committee find a method of testing the number of pounds of oil per cubic foot in the laboratory as a check on the treating plant.

Another thing to do is to find a method of taking samples from barges and cars. There was a paper presented in 1914 showing how hard it was to take a sample from a barge and a car. That question has not been taken up since, and I would like to have it look that up too.

Another suggestion, about these specifications, I would like to have a copy of one of them sent to each of the city engineers who lay wood-block pavement. I think the men who are talking about promotion and publicity cannot find anything better to send out than a report like this,

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showing that this society is taking the initiative, bringing other associations together and making up a specification of this sort.

THE PRESIDENT: Gentlemen, if there is nothing further the Committee will be excused, with the thanks of the Association for its work.

The next thing is the report of the Committee on Resolutions. I will ask the Chairman to come forward and present this report. I hope the members will have patience with us until we get through. We will soon finish the work for the entire session.

MR. WM. A. FISHER: This communication has been handed to the Committee on Resolutions:

To THE RESOLUTIONS COMMITTEE:

The ladies attending the Thirteenth Annual Meeting of the American Wood-Preservers' Association, having been the guests of Mrs. Harrington Emerson at a most enjoyable dinner and theatre party, wish to express their thanks and appreciation of Mrs. Emerson's kindness, and ask that this acknowledgment be given place in the PROCEEDINGS of the Association.

MRS. F. J. ANGIER,
MRS. E. W. BRIGHT,
MRS. WILLIAM A. FISHER,
MRS. F. D. MATTOS,
MRS. C. M. TAYLOR,

Committee.

MR. WM. A. FISHER: I move you that this communication be given a place in the PROCEEDINGS of the Association.

MR. H. I. GOLDSTEIN: I second the motion.

THE PRESIDENT: All those in favor of the motion please signify it by saying "aye"; contrary, "no." The motion is carried.

MR. WM. A. FISHER: We have also this communication:

To THE RESOLUTIONS COMMITTEE:

The ladies attending the Thirteenth Annual Meeting of the American Wood-Preservers' Association wish to express to the Entertainment Committee their thanks and appreciation for the many provisions made for their entertainment and pleasure, and the splendid arrangements that have made their stay in New York one long to be remembered.

MRS. F. J. ANGIER,
MRS. E. W. BRIGHT,
MRS. WILLIAM A. FISHER,
MRS. F. D. MATTOS,
MRS. C. M. TAYLOR,

Committee.

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MR. WM. A. FISHER: I move this also be included in the PROCEEDINGS

MR. L. B. MOSES: I second the motion.

THE PRESIDENT: All those in favor of the motion signify it by saying "aye"; contrary, "no." The motion is carried.

MR. WM. A. FISHER: We now submit the report of the Committee on Resolutions.

REPORT OF COMMITTEE ON RESOLUTIONS.

To the Members of the American Wood-Preservers' Association:

Your Committee endorses the precedent set by the Resolutions Committee of last year, in that the formal complimentary resolutions of former years are omitted. The present Committee joins with the full membership of the Association in its appreciation of the conscientious, constructive work which has characterized the administration of the Association's affairs during the past year, but believes that formal expression of this sentiment is unnecessary.

The Committee feels also that yesterday's action by the Convention in thanking Messrs. Rex and Waterman for their interesting talk and pictures renders further comment unnecessary.

The following subject has been suggested to the Committee and is offered to the Association for its approval:

WHEREAS, It is highly desirable that the interests of the wood-preserving industry be advanced in every legitimate way;

RESOLVED, That the suggestions of the Committee on Publicity, Promotion and Education are heartily endorsed, and that the full co-operation of the membership be offered at every opportunity to improve the work along these lines.

WILLIAM A. FISHER, *Chairman*
F. D. MATTOS
C. M. TAYLOR

MR. WM. A. FISHER: I move the adoption of this resolution.

MR. L. B. MOSES: I second the motion.

THE PRESIDENT: All those in favor of adopting this resolution as read please signify it by saying "aye"; contrary, "no." The motion is carried.

The next in order is New Business.

MR. L. B. MOSES: Mr. President, I would like to suggest just two matters for the attention of the proper committee, or for attention in such way as may be proper. One is in connection with the fire-

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proofing of shingles and other materials in connection with the preservation of material. The thing has been discussed quite a good deal by the members at this meeting, a good deal of it was entirely new, and it seems to me a great deal of it would be interesting to the members of this Association. It is merely a suggestion for investigation by the proper standing committee next year. In the same way a suggestion that some investigation and report be made on open-tank treatments, for next year, going further than the HANDBOOK reference or the Committee on Terminology's reference in this year's report. It seems to me there are a good many places where it is proper to advocate open-tank treatment that we do not know about, and a great many places where it is now improperly advocated that we also do not know about. We ought to know both sides of the thing.

THE PRESIDENT: Anything further? We will now have the announcement of the election results by the tellers.

MR. S. D. COOPER: Mr. President and Gentlemen: The result of the Election is as follows: For President, John Foley (applause); for Vice-President, M. K. Trumbull (applause); for Second Vice-President, J. B. Card (applause); for Secretary-Treasurer, F. J. Angier (applause). For Executive Committee, three years, V. K. Hendricks and C. M. Taylor; for Nominating Committee, W. A. Fisher, E. T. Howson, R. V. Look, F. D. Mattos, August Meyer and A. H. Noyes (applause).

THE PRESIDENT: I will ask Mr. Moses and Mr. Davidson to escort the new President to the Chair.

(Mr. Foley was then escorted to the Chair.)

EX-PRESIDENT CRAWFORD: Gentlemen, I think you made a wise choice.

PRESIDENT-ELECT FOLEY: To attempt to say in appreciation of what you have done for me what I appropriately should would take more time that I am sure you wish to give at this late stage in your sessions. All I can ask for is that the loyalty to the interests of the Association, which has been manifested by your attendance here be given throughout the year. Then there will be no question about the results we will have in 1917. Thank you (applause).

Now, if Mr. Trumbull will be escorted by the same delegation that brought me to the Chair, I will appreciate it. (Applause.)

(Mr. Trumbull escorted to the rostrum.)

MR. M. K. TRUMBULL: I thank you from the bottom of my heart for the honor you have conferred upon me. The Association is in splendid hands with Mr. Foley as its President and Mr. Angier as its Secretary-Treasurer. I am quite sure that we can expect from

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them individually and in co-operation the best of harmony and the best of policies. The Vice-Presidents and the members of the Executive Committee and all of the Committees will endeavor to do their work acceptably. The uppermost thought I now have in my mind is a fervent hope that, when we meet again, a year hence, the terrible nightmare of world war will have passed; the United States and humanity will have profited by the results; more constructive statesmanship will have been established; and the principles of universal peace will have been set forth in such manner that we may never fear the like will occur again. Thank you (applause).

EX-PRESIDENT CRAWFORD: Mr. President, if I am in order, I would just like to make an announcement. I would like to see the members of the old Executive Committee immediately after we adjourn.

PRESIDENT-ELECT FOLEY: I am glad to see that there are enough of them present to make a quorum when we meet. Is Mr. Card present? Well, all of you know Joe Card, and while he is not here to be presented to you, the rest of us who have worked with him in the past know that he is going to do his share towards keeping the Association on an upward trend. Mr. Angier needs no introduction. I am sure you will be glad with me to have him continue in the harness (applause.)

MR. F. J. ANGIER: Mr. President and Gentlemen: This will be the eighth time I have made my little speech, sweet and to the point. I thank you for the honor, and assure you that I will do my best to work for the Association's interests the coming year (applause.)

PRESIDENT-ELECT FOLEY: I can think of no other business that we need to transact before the new officers have a chance to find out how much they can do of the much there is to be done, so I will be glad to entertain a motion to adjourn.

MR. W. F. GOLTRA: I move we adjourn.

MR. W. H. FULWEILER: I second the motion.

PRESIDENT-ELECT FOLEY: It has been regularly moved and seconded that the Thirteenth Annual Meeting of the American Wood-Preservers' Association stands adjourned. Those in favor will say "aye"; contrary, "no." The motion is carried. We hope to see all of you in Chicago this time next year.

An adjournment was then taken.

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STATISTICAL DATA

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QUANTITY OF WOOD TREATED AND PRESERVATIVES USED IN THE UNITED STATES IN 1916.

By R. K. Helphenstine, Jr., U. S. Forest Service.

The American Wood-Preservers' Association

In co-operation with the United States Department of Agriculture, Forest Service, Henry S. Graves, Forester; Office of Industrial Investigations, H. S. Betts, Engineer in Forest Products, in Charge.

Summary.

In 1916 a total of 150,522,982 cubic feet of wood was treated by the 117 treating plants which were active during the year. This is 9,664,019 cu. ft., or 6.9% more than the 140,858,963 ft. of material treated by the 102 plants which reported in 1915.

An increase of 383,783, or 2.5%, was recorded in the number of cross-ties treated during 1916 over the number reported in 1915, while the quantity of piling treated was more by 3,382,448 linear feet, or 36.3%. A gain of 852,171 sq. yds. was also made in the quantity of paving material treated, while the number of cross-arms was greater in 1916 than in 1915 by 145,559, or 99.5%. The largest increase occurred in the number of poles treated, which amounted to more than twice the number reported during the previous year. In only two of the seven classes of material covered by the report were decreases registered in the quantity treated. The items consist of construction timber and miscellaneous lumber and the amounts given fall short of the 1915 figures by 3,119,819 and 913,509 board feet respectively.

The quantity of preservatives used by the industry during 1916 in the treatment of the 150,522,982 cu. ft. of wood reported amounted to 90,404,749 gallons of creosote and refined water-gas-tar, 26,746,577 pounds of zinc chloride, 5,675,095 gallons of paving oil and 582,754 gallons of miscellaneous preservatives. The amount of creosote and refined water-gas-tar used was greater in 1916 than in the year previous by 9,545,307 gallons, while a decrease of 6,523,027 pounds was recorded in the consumption of zinc chloride. The quantity of paving oil reported exceeded the 1915 figures by 2,469,532 gals., and of miscellaneous preservatives was less than one-third of the 1915 consumption.

Source of Statistics.

In the compilation of the 1916 statistics a carefully prepared mailing list was used, which comprised a total of 128 plants of all types. The treating plants of the United States have been considered under

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TABLE 1.—TREATING PLANTS IN THE UNITED STATES, 1916.

Status	COMMERCIAL			RAILROAD			PRIVATE			
	Pressure	Non-pressure	Pressure and non-pressure	Pressure	Non-pressure	Pressure and non-pressure	Pressure	Non-pressure	Pressure and non-pressure	Total
Active	62	5	4	27	1	1	5	11	1	117
Idle	0	1	0	1	0	0	0	5	0	7
Abandoned	0	1	0	0	0	0	0	3	0	4
Total	62	7	4	28	1	1	5	19	1	128

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three main classes of commercial plants, railroad plants and private plants. They are further divided into pressure plants, non-pressure plants and those equipped for both kinds of treatment. The number and type of each class included in the list used, together with the number which were active, idle or abandoned during the year are shown in Table 1.

Of the 117 plants shown as being active during 1916, a total of 110 furnished signed schedules of their activities for the period covered by the report. For the remaining seven estimates were computed, based on the reports submitted by other plants of the same type and relative equipment. This was done to make the statistics more complete and to harmonize the 1916 figures with those for 1915, in connection with the compilation of which similar estimates were made for several delinquent plants.

The gradual increase from year to year in the quantity of preservatives consumed and the corresponding increase in material treated is indicative of the growth of the industry. Extensive research work in reference to the treatment of wood, covering plant equipment, specifications for preservatives, processes and similar scientific investigations has resulted in more or less standardization along these lines.

As shown in Table 1, most of the treating plants of this country are of the pressure-cylinder type. The data presented in this report cover only the consumption of preservatives and material treated by those establishments which maintain treating-plant equipment. It does not include brush-treated material or that treated with temporary apparatus in small amounts for special purposes. Consumers of this character are so numerous that it would be a difficult matter to obtain such statistics.

As customary in conducting this work, the statistics were collected entirely by correspondence. All individual reports are considered confidential, and the amounts are published in a manner not likely to disclose the operations of individual plants. In view of the broad field covered by the work, it is felt that the statistics as presented portray the activities of the industry as a whole as completely and accurately as practicable.

The objects in collecting the statistics are:

1. To show the progress of wood preservation in the United States.
2. To indicate the relative demand for the different preservatives in the various regions of the United States.
3. To show the amount of timber treated by species and classes of material as an aid for suggesting new fields of development for individual treating plants.

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4. To show the quantities of imported and domestic creosote consumed, thus pointing out the principal sources of supply.

Consumption of Preservatives.

Table 2 shows the consumption of wood-preservatives used by the treating plants in the United States by years and kinds of preservatives. An increase in the quantity of creosote consumed is shown for each year from 1909 to 1913, the latter year indicating the greatest consumption so far reported by the industry. The amount used in 1916 shows an increase of 9,545,307 gallons, or 11.8%, over the quantity reported in 1915. Since 1914 paving oil has been shown separately, while for previous years it was included in the figures given for creosote. The consumption of paving oil in 1916 was 5,675,095 gallons, or 2,469,532 gallons more than was reported by the plants in 1915.

During 1916 a total of 26,746,577 pounds of zinc chloride was used by the treating plants of this country, which amounts to 6,523,027 pounds, or 19.6%, less than the quantity reported in 1915. Approximately one-fourth of the total quantity used was reported in 50% solution.

TABLE 2.—CONSUMPTION OF WOOD PRESERVATIVES BY THE TREATING PLANTS OF THE UNITED STATES, 1909 TO 1916.

Year	Number of plants	Creosote(d)	Zinc chloride	Other preservatives(a)
		Gallons	*Pounds*	*Gallons*
1909	64	51,431,212	16,215,107	(b)
1910	71	63,266,271	16,802,532	2,333,707
1911	80	73,027,335	16,359,797	1,000,000
1912	84	83,666,490	20,751,711	3,072,462
1913	93	108,373,359	26,466,803	3,885,738
1914	94	79,334,606	27,212,259	9,429,444(c) 2,486,637
1915	102	80,859,442	33,269,604	3,205,563(c) 1,693,544
1916	117	90,404,749	26,746,577	5,675,095(c) 582,754

(a) Includes refined coal-tar, corrosive sublimate, sodium fluoride, and carbolineum oils.
(b) Statistics not available.
(c) Paving oil.
(d) Includes coal-tar creosote and water-gas-tar.

It will be noted that the quantity of miscellaneous preservatives reported for 1916 is less by over 1,100,000 gallons than the figure given for the 1915 consumption.

Table 3 shows the range of prices paid for creosote and zinc chloride for both 1915 and 1916 by regions.

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TABLE 3.—PRICES PAID FOR PRESERVATIVES, 1915 AND 1916.

Region	1915		1916	
	Creosote (Per gallon)	Zinc chloride (Per pound)	Creosote (Per gallon)	Zinc chloride (Per pound)
Altantic Coast	$0.07 to $0.09	$0.038	$0.075 to $0.09	$0.06 ...
Southern Coast	.064 " .1084	.03 to $0.065	.08 " .1014	.0325 to $0.095
Interior Eastern	.07 " .095	.035 " .0675	.075 " .095	.058 " .075
Interior Western	.075 " .135	.033 " .0475	.075 " .135	.0533 " .074
Pacific Coast	.075 " .13	.035 " .0473	.075 " .135	.0533 " .065

NOTE.—Does not include refined water-gas-tar, which ordinarily costs about one-half the price of coal-tar creosote.

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Table 4 shows the monthly importation of creosote in 1915 and 1916. The total for 1916 indicates that the treating plants consumed slightly less than was reported as having been imported into the United States. This difference may be accounted for by the fact that the treating plants probably did not use all of the foreign oil purchased and for the reason that some of the excess was no doubt employed in the brush treatment of wood, the manufacture of preservative paints or stains and for similar miscellaneous purposes.

TABLE 4.—MONTHLY IMPORTS OF CREOSOTE INTO UNITED STATES, 1915 AND 1916.*

Month	1915	1916
	Gallons	*Gallons*
January	178,841	5,477,439
February	2,058,635	2,722,797
March	1,108,970	5,121,242
April	2,547,635	5,657,982
May	7,173,847	3,757,459
June	5,220,554	1,608,927
July	2,060,815	6,919,870
August	1,511,986	2,765,121
September	3,870,050	3,442,296
October	4,683,304	1,554,169
November	3,712,782	5,279,003
December	314,609	2,538,112
Total	34,442,028	46,844,417

*Monthly summary of Foreign Commerce of the United States Bureau of Foreign and Domestic Commerce.

The relative quantities of foreign and domestic creosote used in 1916 are shown in Table 5. The importation for 1916 is greater than for the previous year by 6,148,924 gallons, or an increase of 16.4%. Of the total amount of foreign oil reported by the plants 41,531,091 gallons were obtained from England, 962,839 from Japan, 741,611 from Canada and 414,390 from Germany.

TABLE 5.—QUANTITIES OF DOMESTIC AND IMPORTED CREOSOTE USED IN THE UNITED STATES, 1909 TO 1916.

Year	creosote used Total	creosote Domestic	of total Per cent	creosote Imported	of total Per cent
	Gallons	*Gallons*		*Gallons*	
1909	51,426,212	13,862,171	27	37,569,041	73
1910	63,266,271	18,184,355	29	45,081,916	71
1911	73,027,335	21,510,629	29	51,516,706	71
1912	83,666,490	31,135,195	37	52,531,295	63
1913	108,373,359	41,700,167	38	66,673,192	62
1914	79,334,606	28,026,870	35	51,307,736	65
1915	80,859,442	43,358,435(a)	54	37,501,007	46
1916	90,404,749	46,754,818(b)	52	43,649,931	48

(a) 41,333,890 gallons coal-tar creosote and 2,024,545 gallons water-gas-tar.
(b) 45,318,735 gallons coal-tar creosote and 1,436,083 gallons water-gas-tar.

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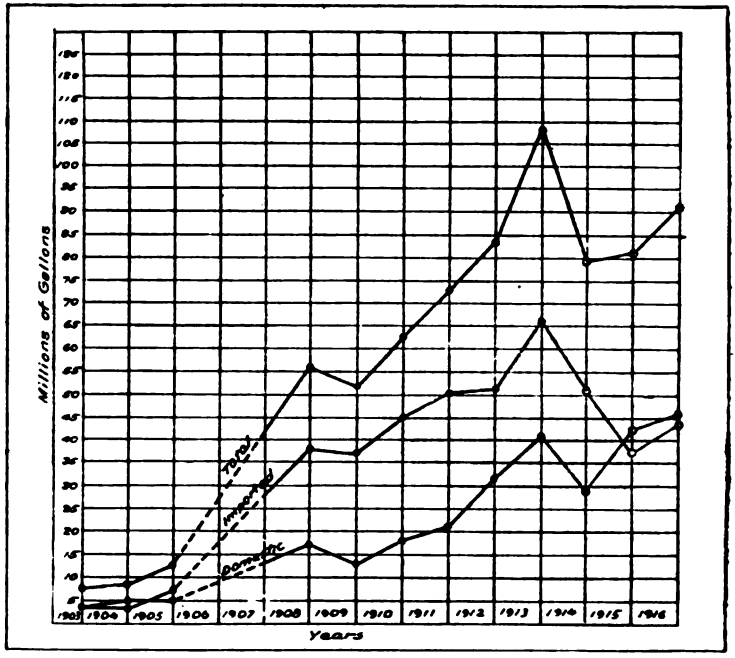
PROGRESS OF WOOD PRESERVATION IN THE UNITED STATES.
Consumption of Creosote, 1903-1916.



Note: Figures not available for years 1906-1907.
OFFICE OF INDUSTRIAL INVESTIGATIONS, U. S. FOREST SERVICE.

Regional Division of the Wood-Preserving Industry.

In compiling the statistics on wood preservation in the United States the total area of the country has been divided into five main divisions, as shown on the accompanying map. Table 6 gives the figures for these regions and shows both the quantity of preservatives consumed and the amount of material treated by the plants embraced in each region. The material is here shown in the form and quantity as reported by the plants instead of in cubic feet as presented in Table 10.

The divisions shown were made with a view of conforming the areas embraced as far as practicable to the Forest Service subdivisions into which this country's original forests have been divided. The divisions referred to are as follows:

1. ATLANTIC COAST REGION, embracing the Northern Forest, made up largely of white pine, spruce, hemlock, tamarack and their associated species.

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TABLE 6.—MATERIAL CONSUMED IN WOOD PRESERVATION IN UNITED STATES, 1915 AND 1916.

Region	Year	Number of plants		Domestic creosote	Foreign creosote	Zinc chloride	Other preservatives	Hewed ties	Sawed ties	Piles	Poles	Paving blocks	Construction timber	Cross-arms	Miscellaneous
				Gallons	*Gallons*	*Pounds*	*Gallons*	*Number*	*Number*	*Lin. ft.*	*Number*	*Sq. yds.*	*Bd. ft.*	*Number*	*Bd. ft.*
Atlantic Coast	1915	20		12,277,532	17,959,083	2,077,877	50,080	5,339,088	2,089,847	3,500,821	11,697	552,095	28,298,805	16,757	4,634,655
	1916		21	15,240,997	8,805,439	1,879,376	148,550	3,809,070	1,707,910	4,347,824	12,992	405,267	30,108,195	18,425	2,761,503
Southern Coast	1915	27		10,774,698	15,079,315	9,767,867	.....	8,519,038	439,255	3,817,927	66,216	806,968	77,798,523	121,945	3,658,227
	1916		31	13,722,940	24,206,836	5,827,206	389,066	8,524,223	2,527,785	5,539,949	138,656	1,141,063	69,260,630	197,103	7,773,725
Interior Eastern	1915	29		20,594,325	1,739,349	12,764,798	1,640,102	10,403,406	4,246,896	138,639	32,503	1,509,755	18,914,931	2,211	1,809,064
	1916		33	20,301,735	5,712,796	12,818,944	24,000	12,373,774	2,820,966	75,301	102,233	1,827,327	20,871,615	11,905	950,038
Interior Western	1915	10		1,809,854	585,557	6,441,138	.....	1,475,478	2,526,400	3,010	3,107	1,000	6,628,575	56	3,398,959
	1916		14	1,093,620	1,904,804	3,967,535	2,002	1,731,386	1,569,879	120,250	11,441	.....	8,563,644	78	1,186,539
Pacific Coast	1915	16		1,107,589	2,137,703	2,217,924	3,362	94,194	1,951,983	1,848,022	12,116	66,552	10,368,207	5,250	436,604
	1916		18	2,070,743	3,020,056	2,253,516	19,136	61,501	2,342,874	2,607,543	63,195	414,884	10,085,138	64,267	352,195
Grand total	1915	102		43,358,435	37,501,007	33,269,604	1,693,544	25,831,204	11,254,381	9,308,419	126,056	2,936,370	142,009,041	146,219	13,937,509
	1916		117	52,430,035	43,649,931	26,746,577	582,754	26,499,954	10,969,414	12,690,867	328,517	3,788,541	138,889,222	291,778	13,024,000

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2. SOUTHERN COAST REGION, which practically covers the territory included in the Southern Forest where the yellow pines predominate.

3. INTERIOR EASTERN REGION, comprising the Hardwood Forest, the only region in the United States where the hardwoods, such as oak, maple and beech, predominate.

4. INTERIOR WESTERN REGION, coinciding with the Rocky Mountain Forest, throughout which western yellow pine occurs in company with lodgepole pine, larch, and other softwoods.

5. PACIFIC COAST REGION, the area covered by the Pacific Forest, where conifers such as Douglas fir, redwood, and western yellow pine occur almost to the exclusion of hardwoods.

Consumption of Preservatives and Treatment of Material.

ATLANTIC COAST REGION.

There was used by the 21 active plants of this region a total of 24,046,436 gallons of creosote and refined water-gas-tar, of which 15,240,997 gals. were of domestic and 8,805,439 gals. of foreign manufacture. As was the case in 1915 the consumption of zinc chloride in this region was least, amounting to 1,879,376 pounds. Nearly 150,000 gals. of miscellaneous preservatives were employed by the plants of the region.

The total number of cross-ties treated in 1916 was less by 1,911,955 than during the previous year, while the quantity of piling exceeded the 1915 figures by 847,003 linear feet. The 12,992 poles and the 30,108,195 board feet of construction timber treated by the plants of the region represent increases over the amounts reported for 1915 of 1,295 board feet of the former and 1,809,390 board feet of the latter. The quantity of paving blocks and miscellaneous material reported in 1916 are less than for the year previous by 146,828 sq. yds. and 1,873,152 board feet, respectively. A slight increase, amounting to 1,668 pieces, was registered in the treatment of cross-arms.

SOUTHERN COAST REGION.

This region headed the list in 1916 in the consumption of creosote, the total amount used by the 31 reporting plants being 37,929,776 gals., of which 13,722,940 were of domestic and 24,206,836, or nearly twice as much, of foreign manufacture. The region stood second in point of zinc-chloride consumption, the quantity used being 5,827,206 lbs. or slightly more than half the amount reported in 1915. Nearly two-thirds of the total amount of miscellaneous preservatives reported for the entire United States were used by the plants of the Southern Coast Re-

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gion in 1916, the quantity being 389,066 gals., where none was employed in the year previous.

Increases occurred in the quantity treated by the plants of this region in 1916 over 1915 in all but one of the seven classes of material shown in Table 6. The one class which showed a less amount was construction timber, of which there was treated 69,260,630 board feet as compared with 77,798,523 for the year before.

INTERIOR EASTERN REGION.

This region contains the greatest number of plants. The total of 33 which reported consumed the largest quantity of zinc chloride and next to the largest amount of creosote. Of the former 12,818,944 lbs. were used, and of the latter 26,014,531 gals. The plants of the region also employed 24,000 gals. of miscellaneous preservatives.

The number of cross-ties treated by these plants was greater in 1916 than in 1915 by 544,438, while the quantity of piling was less by 63,338 linear feet. Over 60,000 more poles, 317,572 more sq. yds. of paving blocks, 9,694 cross-arms and 1,956,684 board feet of construction timber were reported treated in this region in 1916 than in 1915. The quantity of miscellaneous lumber subjected to treatment was less by nearly 50%.

INTERIOR WESTERN REGION.

The plants of this region reported the smallest creosote consumption. The number of gallons used was 2,998,424, of which 1,093,620 were domestic and 1,904,804 imported. The former represents a decrease from the quantity reported in 1915 of 716,234 gals., while the latter shows a gain of 319,247 gals. Though this region ranked third in the quantity of zinc chloride consumed, the quantity reported was a little more than half of the consumption for 1915. In addition to the creosote and zinc chloride reported, there were used 2,002 gals. of miscellaneous preservatives.

The number of cross-ties treated by these plants was 3,301,265, or 700,613 less than the figure for 1915. A notable increase occurred in the quantity of piling treated in 1916, which amounted to 117,240 linear feet as compared with 3,010 linear feet for the year before. A corresponding increase was recorded in the number of poles treated, which in 1916 amounted to 11,441 as against 3,107 in 1915. Where 1,000 sq. yds. of paving blocks were run through the cylinders of the plants of this region in 1915, none were treated in 1916. Table 6 also shows an increase for this region in the quantity of construction timber treated, the figures for 1916 being 8,563,644 board feet as compared with 6,628,575 board feet for last year. Only 78 cross-arms were treated, while

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less than half the quantity of miscellaneous lumber shown by the 1915 figures was reported in 1916.

PACIFIC COAST REGION.

Eighteen plants were active in the Pacific Coast Region during the year. They consumed 2,070,743 gals. of domestic and 3,020,056 gals. of imported creosote, a combined consumption of 1,845,507 gals. more than was shown by the 1915 figures. These plants also used 2,253,516 lbs. of zinc chloride and 19,136 gals. of miscellaneous preservatives.

The number of cross-ties treated exceeded the number in 1915 by 358,198, while the quantity of piling reported shows an increase of 759,-521 linear feet. Over five times as many poles and more than six times as many paving blocks were reported in 1916 than in 1915. The quantity of construction timber subjected to treatment was less than for the year previous by 283,069 board feet, while the number of cross-arms reported was over 12 times as many. The amount of miscellaneous timber treated was less than for the year before by 84,409 board feet.

Preservation of Ties.

Since the wood-preserving industry in this country has been built very largely upon the treatment of railroad timber, principally ties, this class of material constitutes the bulk of the total quantity of wood treated. In 1916 there were reported a total of 150,522,982 cu. ft. of material subjected to preservative treatment, of which 112,408,104 cu. ft., or over 75%, were ties. The actual number of ties treated was 37,469,-368, an increase of 383,783 over the number recorded in 1915. Of this quantity 26,499,954 were sawed and 10,969,414 hewed.

Oak ties again lead in the number treated, constituting 44.9% of the total number reported. Yellow pine ties representing 28.1% ranked second, while Douglas fir ties came third with 8.1%. The number of ties of each kind of wood reported, the per cent. which each represents of the total, and the kind of preservative employed in their treatment, are shown in Table 7.

The number of ties treated with creosote was 20,858,801, and with zinc chloride 14,619,676. The number of ties treated with these two preservatives in the form of an emulsion was 1,978,414, while 12,477 were subjected to treatment with miscellaneous preservatives. In treating ties with creosote and refined water-gas-tar the average impregnation was 8.09 lbs. per cubic foot, while for zinc chloride it was 0.50 lb. per cubic foot. Where ties were treated with the emulsion the quantity of preservative forced into the wood averaged 2.75 lbs. of creosote and refined water-gas-tar and 0.48 lb. of zinc chloride. The Bethell,

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TABLE 7.—NUMBER OF CROSS-TIES TREATED IN UNITED STATES IN 1916.

Preservative	Oak	Yellow pine	Douglas fir	Western pine	Beech	Gum	Tamarack	Maple	Birch	Elm	Other species	Total
Creosote	8,176,923	8,549,861	783,583	671,557	1,326,890	80,285	432,414	280,189	138,791	.....	418,308	20,858,801
Zinc chloride	7,349,883	1,615,900	2,223,803	1,012,605	261,911	57,494	931,755	121,286	61,300	47,309	936,430	14,619,676
Zinc chloride and creosote	1,305,309	343,021	.....	.....	88,683	10,720	.....	60	.....	3,709	226,912	1,978,414
Miscellaneous	.....	.....	12,477	.....	.....	.....	.....	.....	.....	.....	.....	12,477
Total	16,832,115	10,508,782	3,019,863	1,684,162	1,677,484	148,499	1,364,169	401,535	200,091	51,018	1,581,650	37,469,368
Per cent of total treated	44.9	28.1	8.1	4.5	4.5	0.4	3.6	1.1	0.5	0.1	4.2	100.0

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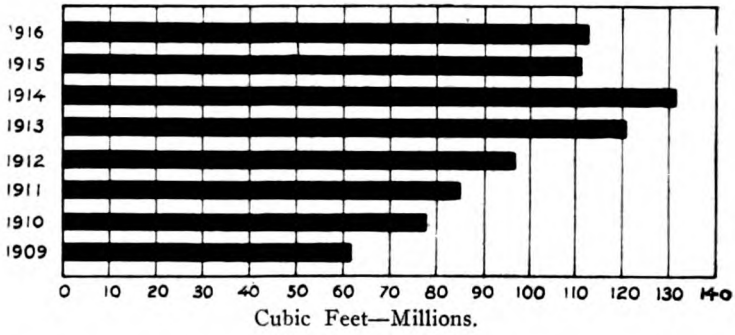
CROSS-TIES TREATED.



Boulton, Burnett, Card, Lowry, Rueping and open-tank processes were employed by the plants in the treatment of ties in 1916.

Table 8 shows comparatively the number of cross-ties purchased in 1915 by the principal classes of consumers and the quantity subjected to treatment during the same year.

TABLE 8.—CROSS-TIES PURCHASED AND TREATED IN 1915.

Species	Number purchased	Number treated	Per cent treated of total purchased(a)
Oak	49,333,881	16,885,517	34.22
Yellow pine	14,115,681	8,541,203	60.50
Douglas fir	6,950,910	3,553,854	51.12
Beech	1,173,490	2,933,737	(a)
Western pine	2,719,655	2,007,609	73.81
Tamarack (b)	3,858,098	932,038	24.15
Gum	485,466	277,886	57.24
Birch	465,815	173,971	37.39
Maple	1,069,547	36,942	3.45
All other (c)	16,934,108	1,742,828	10.28
Total	97,106,651	37,085,585	38.19

(a) Since railroads often purchase large quantities of ties in one calendar year which do not receive preservative treatment until one or more years following, it is impossible to harmonize the data showing ties purchased with that showing ties treated.

(b) Includes western larch.

(c) Includes elm, of which there were treated in 1915 a total of 50,846.

NOTE.—It was intended that these data be included in the 1915 statistics, but the compilations of ties purchased were not completed in time to incorporate them in last year's report. For this reason the number of ties treated and purchased in 1915 are shown in order to make the table entirely comparable.

Preservation of Piles.

The quantity of piles treated in 1916 amounted to 12,690,867 linear feet, or 3,382,448 linear feet more than are shown by the figures for the

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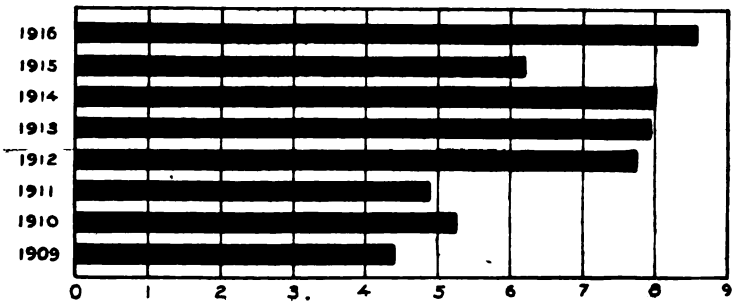
previous year. The principal species of wood represented are yellow pine and Douglas fir. The Southern Coast Region ranked first in the quantity treated with 5,539,949 linear feet, while next in importance was the quantity reported from the Atlantic Coast Region, amounting to 4,347,824 linear feet. The Pacific Coast Region was third with a total of 2,607,543 linear feet, while the combined quantities subjected to treatment in the plants of the Interior Eastern and Interior Western regions totaled 195,551 linear feet.

Bethell, Boiling, Burnett, Card, Lowry and Rueping were the processes used by the plants for the treatment of piles.* Where creosote was used the average injection amounted to 14.36 pounds per cubic foot, and with zinc chloride it was 0.43 pound per cubic foot.† With the use of the zinc-creosote emulsion the average amount of preservatives forced into the wood was 1.958 pounds of creosote and 0.43 pound of zinc chloride per cubic foot.

PILES TREATED.



Cubic Feet—Millions.

Preservation of Poles.

It is probable that as many more poles are subjected to some kind of preservative treatment as are reported by the treating plants. Such treatment, however, consists practically altogether of dipping or painting (brush treatment). Since this report includes only those poles which were treated in cylinders or open-tank plants, it does not cover material of the kind first referred to. The number of poles treated in 1916 was 328,517, or 202,461 more than were reported in 1915.

In the treatment of poles the Bethell, Burnett and Lowry and open-tank processes were used. Where straight creosote was employed the

*Though not reported, the Boulton process was probably used on the Pacific Coast.

†The injection shown for creosote is an average for piles for both land and water use. The average for the two classes separately would probably be from 7 to 14 pounds per cubic foot for the former and around 20 pounds for the latter.

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average injection of the preservative was 13.32 pounds per cubic foot, while for zinc chloride an average impregnation of 0.50 pound per cubic foot was obtained.

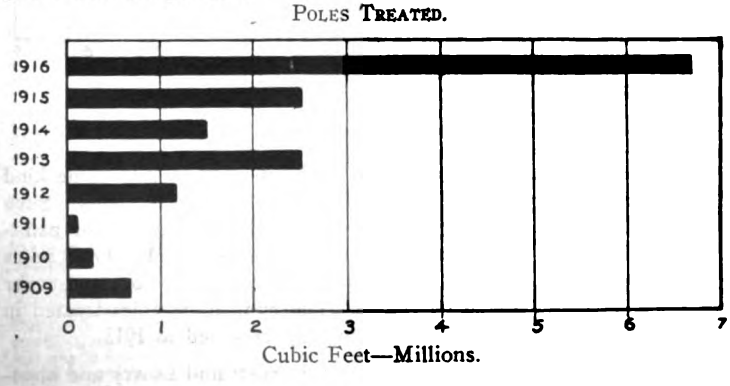
Table 9 shows the total number of poles purchased by the principal classes of consumers in 1915 arranged according to species and the total number treated. Since few of the treating plants indicate the kinds of wood represented in reporting the quantity of poles treated,

TABLE 9.—POLES PURCHASED IN 1915.

Species	Number purchased
Northern white cedar	1,747,210
Chestnut	651,643
Western red cedar	567,770
Pine	546,233
White oak	177,799
Red cedar	117,545
Southern white cedar	89,244
Cypress	67,644
Red oak	21,643
All other	91,233
Total	4,077,964
Number treated	125,639(a)
Per cent treated of total purchased	3.1

(a) Includes 90,766 cedar poles treated by open-tank process and 198,116 southern yellow pine poles treated by Bethell or Lowry processes.

the only figures which can be taken as a basis for comparison are the totals shown for the number purchased and the number treated, together with the per cent.



Preservation of Paving Blocks.

The quantity of paving material treated in 1916 shows an increase over the 1915 figures of 852,171 sq. yds. The total for the year was 1,788,541 sq. yds. The percentage of increase was greatest in the Pa-

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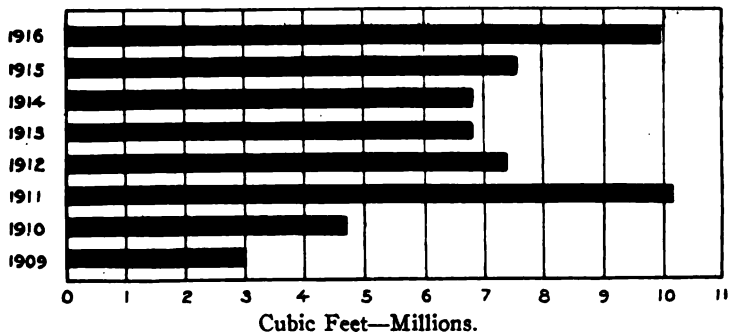
cific Coast Region, where 414,884 sq. yds. were treated during 1916 as compared with 66,552 in 1915. The Interior Eastern and Southern Coast regions also contributed to the increase with 317,572 and 334,095 sq. yds., respectively. Where 1,000 sq. yds. were reported by the Interior Western Region in 1915, none was treated in that region this year.

Yellow pine blocks were first in importance, the quantity treated being nearly six times the total number of all other species combined. Douglas fir blocks ranked second with a total of 409,569 sq. yds. treated, followed by 220,955 sq. yds. for tamarack, 6,849 sq. yds. of Norway pine, 6,098 sq. yds. of western larch and 4,400 sq. yds. of sugar maple, the latter wood never having been reported before.

All but about 1,000 sq. yds. of the total quantity reported were treated with creosote, refined water-gas-tar, paving oil or a mixture of these preservatives, the average impregnation being 13.83 lbs. per cubic foot. The remainder were treated with 0.53 lb. of zinc chloride per cubic foot.

The Bethell, Boiling, Burnett, Lowry and Rueping processes were employed.

PAVING BLOCKS TREATED.



Preservation of Construction Timber.

The material included under this heading consists principally of bridge timber, switch-ties and other heavy structural material. The total amount of material of this class which was impregnated with preservatives in 1916 by the treating plants of this country was 138,889,-222 board feet, a decrease from the quantity reported in 1915 of 3,119,-819 board feet.

As was the case in 1915, the Southern Coast Region reported the largest amount of construction timber treated, the quantity being 69,-

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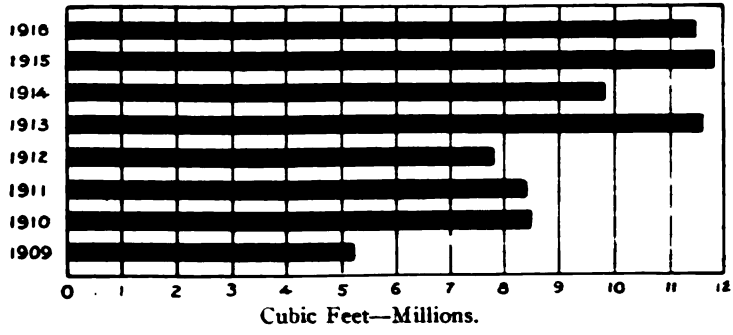
260,630 board feet, or nearly 50% of the total quantity shown. The Atlantic Coast Region took second place with 30,108,195 board feet.

Yellow pine constituted the major portion of the material treated, except in the Pacific Coast Region, where it consisted entirely of Douglas fir.

The average quantity of creosote forced into the wood was 11.65 pounds per cubic foot, while for zinc chloride it amounted to 0.45 pound per cubic foot. Some plants used these two preservatives in combination, and secured an average absorption per cubic foot of 2.40 pounds of creosote and refined water-gas-tar and 0.498 pound of zinc chloride.

Practically all treating processes were used, including the Bethell, Boiling, Boulton, Burnett, Card, Lowry, Rueping and open-tank.

CONSTRUCTION TIMBER TREATED.



Preservation of Cross-Arms.

The largest quantity of this class of material was treated by the plants of the Southern Coast Region, the number reported being 197,103, or an increase of 75,158 over the number treated in 1915. A marked increase occurred in the number of cross-arms treated in the Pacific Coast Region, where 64,267 were run through the cylinders in 1916, or more than 12 times the number reported in the year previous. The total number reported by all plants was 291,778.

Creosote with an average injection of 10.73 pounds per cubic foot was the only preservative used, and the processes employed were the Bethell, Rueping and open-tank.

Preservation of Miscellaneous Lumber.

The material included under this heading consists of mine props, tunnel sets, dowels, tie plugs, drain boxes, shingles, pipe staves, signboard lumber, fence posts, factory sub-flooring, conduits, trunking and

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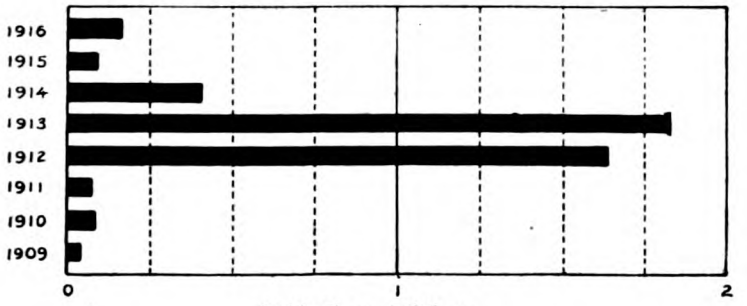
CROSS-ARMS TREATED.



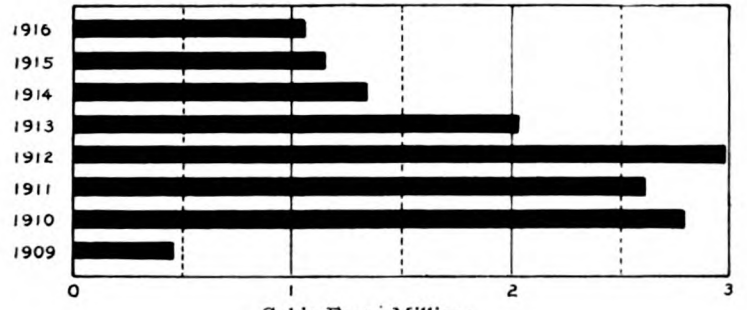
Cubic Feet—Millions.

capping, cattle guards, dead men, pole steps and miscellaneous lumber and planking. The total amount of this class of material reported was 13,024,000 board feet, or 913,509 board feet less than was treated in 1915.

Three kinds of preservatives were used in the treatment of the quantity reported, namely, creosote, zinc chloride and sodium fluoride. For the first mentioned the average absorption was 10.69 pounds per cubic foot, for the second 0.50 pound per cubic foot, and for the third, which makes its first appearance in these statistics, the quantity was 0.33 pound per cubic foot.

The Bethell, Boulton, Burnett, Lowry and Rueping and open-tank processes were used.

MISCELLANEOUS LUMBER TREATED.



Cubic Feet—Millions.

Table 10 gives a summary in cubic feet of the total amount of material treated in each class from 1909 to 1916. It also shows the amount of material treated for these years with the various preservatives employed. Formerly the quantity of each class of material treated with

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miscellaneous preservatives was included in the grand totals. In this table, however, these items are shown separately..

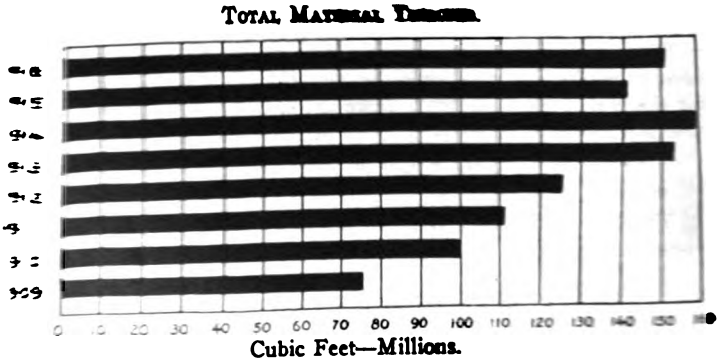

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TABLE 10.—MATERIAL TREATED IN THE UNITED STATES, 1909 TO 1916.

Preservatives	Year	Cross-ties	Piles	Poles	Paving blocks	Cross-arms	Construction timber	Miscellaneous lumber	Total material treated
		Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.
Creosote	1909	29,830,080	4,421,726	659,664	2,994,290	41,764	4,902,311	417,787	43,267,622
	1910	44,525,229	5,219,254	255,597	4,692,453	88,069	7,801,272	2,687,713	65,269,587
	1911	49,532,163	4,937,363	106,213	10,145,724	71,961	7,417,105	2,499,995	74,710,524
	1912	57,461,515	7,624,939	1,169,981	7,091,658	1,643,128	6,892,493	2,841,195	84,724,909
	1913	75,998,307	7,630,328	2,367,769	6,810,308	1,813,010	10,308,883	1,853,993	106,782,598
	1914	67,774,329	7,804,657	1,188,511	3,127,506	395,403	8,389,158	1,348,566	90,028,130
	1915	51,231,207	6,288,238	2,336,318	6,064,758	87,373	9,264,164	881,028	76,153,086
	1916	62,576,403	8,524,680	6,303,954	7,205,953	178,210	9,521,609	691,870	95,002,679
Zinc chloride	1909	24,153,162	(a)	(a)	(a)	(a)	320,891	2,333	24,476,386
	1910	27,587,583	(a)	(a)	(a)	(a)	541,514	71,060	28,200,157
	1911	28,337,883	(a)	(a)	(a)	(a)	1,043,851	119,931	29,501,665
	1912	28,532,874	(a)	18,246	(a)	(a)	259,972	20,092	28,831,184
	1913	36,051,816	(a)	47,996	(a)	(a)	585,756	7,670	36,693,238
	1914	50,020,755	(a)	(b)	(a)	(a)	1,317,925	4,355	51,343,035
	1915	53,457,852	4,726	(a)	(a)	(a)	2,406,150	275,279	56,144,007
	1916	43,859,028	859	164	(a)	(a)	1,526,881	346,047	45,732,979
Zinc-creosote	1909	8,095,794	(a)	(a)	(a)	(a)	62,918	43,699	8,202,411
	1910	6,354,219	38,392	(a)	(a)	(a)	181,143	30,646	6,604,400
	1911	7,312,374	(b)	(a)	(a)	(a)	(b)	(b)	7,312,374
	1912	8,214,303	97,874	(a)	(a)	(a)	560,613	99,367	8,972,157
	1913	6,938,838	327,594	(a)	(b)	(a)	758,989	53,628	8,079,049
	1914	5,868,834	(a)	(a)	(b)	(a)	140,718	(b)	6,009,552
	1915	6,548,136	2,320	110,220	(a)	(a)	40,396	4,822	6,705,894
	1916	5,935,242	837	53,933	(a)	(a)	359,428	(a)	6,349,440
Miscellaneous	1909	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
	1910	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
	1911	(a)	(a)	(a)	(a)	(a)	(a)	(a)	(a)
	1912	2,974,317	14,222	352	305,437	(a)	80,446	28,032	3,402,806
	1913	1,792,287	(a)	84,655	45,985	11,709	(a)	124,367	2,059,003
	1914	7,877,043	257,245	293,896	3,741,864	22,511	(a)	9,363	12,201,922
	1915	19,560	(a)	66,242	1,643,213	3,254	123,377	330	1,855,976
	1916	37,431	56,458	389,031	2,738,731	2,634	166,183	47,416	3,437,884
All preservatives	1909	62,079,036	4,421,726	659,664	2,994,290	41,764	5,286,120	463,819	75,946,419
	1910	78,467,031	5,257,646	255,597	4,692,453	88,069	8,523,929	2,789,419	100,074,144
	1911	85,182,420	4,937,363	106,213	10,145,724	71,961	8,460,956	2,619,926	111,524,563
	1912	97,183,009	7,737,035	1,188,579	7,397,095	1,643,128	7,793,524	2,988,686	125,931,056
	1913	120,781,248	7,957,922	2,500,420	6,856,293	1,824,719	11,653,628	2,039,658	153,613,888
	1914	131,540,961	8,061,902	1,482,407	6,869,370	417,914	9,847,801	1,362,284	159,582,639
	1915	111,256,755	6,295,284	2,512,780	7,707,971	90,627	11,834,087	1,161,459	140,858,963
	1916	112,408,104	8,582,834	6,747,082	9,944,684	180,844	11,574,101	1,085,333	150,522,982

(a) No statistics; (b) Figures if used would reveal identity of reporting firms.

CONVERTING FACTORS.—To obtain the number of cross-ties, divide by 3; linear feet of piling, divide by 0.6763; poles, divide by 0.5868; square yards of paving blocks, divide by 2.625; cross-arms, divide by 0.6198; board feet of construction timber, multiply by 12; board feet of lumber and miscellaneous material, multiply by 12.

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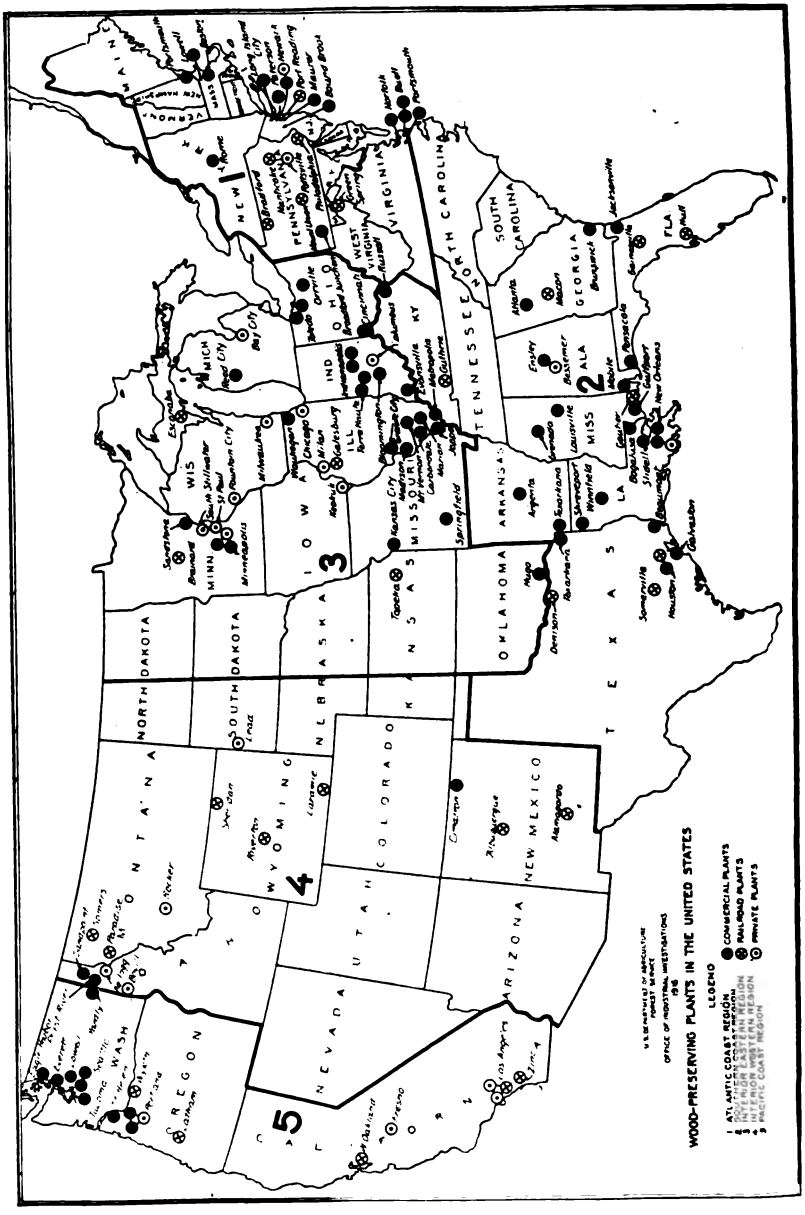

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MILEAGE OF STEAM, HORSE AND ELECTRIC RAILWAYS IN THE UNITED STATES.

Cross-Ties Used and Treated—Treating Plants in Operation.

Year	Steam Railroads		Horse & Elec. Rwys.	Total	Ties used	Ties treated		Treating plants in operation
	First main tracks	Other tracks						
	Miles	*Miles*	*Miles*	*Miles*	*Number*	*Number*	*Per Cent.*	*Number*
1860	30,626	3,000	200	33,826	10,147,800	From 1860 to		
1870	52,922	9,100	1,200	63,222	18,966,600	1885 inclusive	0.10	3
1880	93,267	21,977	2,000	117,244	35,173,200	Approx. 50,000		
1885	123,320	32,868	2,800	158,988	47,696,400	120,000	0.25	5
1886	125,185	34,441	3,120	162,746	48,823,800	510,000	1.04	5
1887	137,028	37,348	3,680	178,056	53,416,800	594,000	1.11	5
1888	145,387	38,221	4,112	187,720	56,316,000	644,000	1.14	6
1889	153,725	42,242	4,930	200,897	60,269,100	615,000	1.02	7
1890	163,597	42,036	5,241	213,874	64,168,200	650,000	1.01	8
1891	168,403	47,746	6,155	222,304	66,691,200	697,000	1.05	8
1892	171,564	50,787	7,040	229,391	68,817,300	790,000	1.15	9
1893	176,461	53,676	8,870	239,007	71,702,100	812,000	1.13	10
1894	178,709	54,825	8,949	242,483	72,744,900	920,000	1.26	11
1895	180,657	56,237	10,810	247,704	74,311,200	1,289,000	1.73	12
1896	182,777	57,352	12,133	252,262	75,678,600	1,307,000	1.73	13
1897	183,284	58,729	13,756	255,778	76,733,400	1,312,000	1.71	13
1898	184,648	60,686	15,942	261,276	78,382,800	1,826,000	2.33	13
1899	187,535	62,608	17,665	267,808	80,342,400	2,510,000	3.12	15
1900	192,556	66,228	19,314	278,098	83,429,400	2,800,000	3.36	15
1901	195,562	69,790	22,217	287,569	86,270,700	4,101,000	4.75	17
1902	200,155	74,041	25,592	299,788	89,936,400	6,180,000	6.87	22
1903	205,314	78,508	27,754	311,576	93,472,800	9,010,000	9.64	27
1904	212,243	84,830	29,548	326,621	97,986,300	12,800,000	13.06	30
1905	216,974	89,823	32,517	339,314	77,982,000	14,890,000	19.09	34
1906	222,340	94,643	36,212	353,195	102,834,000	16,880,000	16.41	39
1907	227,455	100,520	38,812	366,787	153,700,000	19,856,000	12.92	51
1908	229,203	103,152	40,247	372,602	111,780,600	23,776,000	21.27	57
1909	234,059	106,950	40,490	381,499	114,449,700	22,033,000	19.25	68
1910	239,447	110,936	40,088	390,471	117,141,300	30,544,000	26.08	78
1911	244,476	116,586	41,088	402,150	120,645,000	31,141,000	58.81	81
1912	247,981	121,386	42,110	411,477	123,443,100	32,394,000	26.24	87
1913	250,534	126,038	43,043	419,615	125,884,500	40,260,000	32.00	92
1914	253,997	130,656	43,989	428,642	147,592,600	43,847,000	34.37	95
1915	257,569	133,573	46,613	437,755	131,326,500	37,085,585	28.24	102
1916	260,144	136,700	47,721	444,565	133,369,500	37,469,368	28.10	117

Mileage of steam railroads from 1890 to 1914 from records of Interstate Commerce Commission.
Cross-ties used and treated from 1906 to 1911 from Census Reports.
Cross-ties used from 1860 to 1905 and from 1912 to 1916 estimated on basis of 300 ties per mile.

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WOOD-PRESERVING PLANTS IN UNITED STATES, CANADA AND MEXICO.

UNITED STATES.

PRESSURE PROCESSES.

Managing Company	Headquarters	Location of Plant	Year Built	Retorts: Number	Retorts: Diameter Inches	Retorts: Length Feet
American Creosoting Co.	New York, N. Y.	Newark, N. J.	1906	1	78	105
				1	78	165
" " "	Louisville, Ky.	Indianapolis, Ind.	1913	2	64	134
" " "	" "	Marion, Ill.	1907	2	84	134
" " "	" "	Springfield, Mo.	1907	2	84	134
" " "	" "	Kansas City, Mo.	1907	2	84	134
" " "	" "	Russell, Ky.	1915	1	84	134
" " "	" "	Hugo, Okla.	1907	2	84	134
American Creosote Works.	New Orleans, La.	Southport, nr. New Orleans	1901	1	84	172
				1	108	172
" " "	" " "	Louisville, Miss.	1912	1	108	172
Anaconda Copper Mining Co.	Butte, Mont.	Rocker, Mont.	1910	1	72	43
A. T. & S. F. Rwy. Co.	Topeka, Kan.	Albuquerque, N. M.	1908	2	74	132
Atlantic Coast Line R. R. Co.	Wilmington, N. C.	Gainesville, Fla.	1912	2	74	138
Atlantic Creo. & W. P. Wks.	Norfolk, Va.	Norfolk, Va.	1901	1	78	62
				1	78	82
				1	78	126
Ayer & Lord Tie Co.	Chicago, Ill.	Grenada, Miss.	1904	4	74	128
" " " "	" "	Argenta, Ark.	1907	4	74	132
" " " "	" "	Carbondale, Ill.	1902	4	72	122
				4	74	132
Baltimore & Ohio R. R. Co.	Baltimore, Md.	Green Spring, W. Va.	1912	2	84	132
Barber Asphalt Paving Co.	Maurer, N. J.	Maurer, N. J.	1905	4	72	115
Boston Elevated Rwy. Co.	Boston, Mass.	South Boston, Mass.	1916	1	90	51
Buffalo, Rochester & Pitsburgh R. R. Co.	Rochester, N. Y.	Bradford, Pa.	1910	1	75	95
Bunker Hill & Sullivan Mg. Co.	Kellogg, Idaho	Kellogg, Idaho	1908	1	84	10
Carbolineum Wood Pres. Co.	Portland, Ore.	Portland, Ore.	1901	1	..	...
Central Creosoting Co.	Chicago, Ill.	Waukegan, Ill.	1907	2	72	134
" " "	" "	Terre Haute, Ind.	1912	2	132	20
Central of Ga. R. R. Co.	Macon, Ga.	Macon, Ga.	1912	2	84	116
Central R. R. of New Jersey.	Port Reading, N. J.	Port Reading, N. J.	1912	2	88	140
Charlotte Harbor & No. Ry. Co.	Boca Grande, Fla.	Hull, Fla.	1912	1	74	73
C. B. & Q. R. R. Co.	Chicago, Ill.	Galesburg, Ill.	1907	5	74	132
" "	" "	Sheridan, Wyo.	1899	2	74	132
Chicago & N. W. Ry. Co.	" "	Escanaba, Mich.	1903	3	72	112
" " "	" "	Riverton, Wyo.	1915	1	72	110
Colman Co., J. M.	Seattle, Wash.	West Seattle, Wash.	1884	3	75	120
Colonial Creosoting Co.	Louisville, Ky.	Bogalusa, La.	1912	2	72	134
Columbia Creosoting Co.	Portland, Oregon	Linnton, nr. P'tland, Ore.	1912	1	72	132
				1	72	65
Compressed Wood Preserving Co.	Cincinnati, O.	Cincinnati, O.	1909	2	72	76
Continental Tie & Lbr. Co.	Denver, Colo.	Cimarron, N. M.	1913	1	84	87
El Paso & S. W. R. R. Co.	El Paso, Tex.	Alamogordo, N. M.	1902	2	72	106
Eppinger & Russell Co.	New York, N. Y.	Long Island City, N. Y.	1878	4	72	100
" " " "	" " "	Jacksonville, Fla.	1909	3	84	130

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Wood-Preserving Plants in United States.—(Continued)

Managing Company	Headquarters	Location of Plant	Year Built
ederal Creosoting Co.	Louisville, Ky.	Bound Brook, N. J.	1909
" " "	" "	Toledo, O.	1909
" " "	" "	Rome, N. Y.	1910
" " "	" "	Paterson, N. J.	1909
eorgia Creosoting Co.	Louisville, Ky.	Brunswick, Ga.	1915
reat Northern Ry. Co.	St. Paul, Minn.	Somers, Mont.	1901
ulfport Creosoting Co.	Gulfport, Miss.	Gulfport, Miss.	1906
diana Creosoting Co.	Louisville, Ky.	Bloomington, Ind.	1907
diana Tie Co.	Evansville, Ind.	Evansville, Ind.	1907
" " "	Evansville, Ind.	Joppa, Ill.	1909
diana Zinc Creosoting Co.	Terre Haute, Ind.	Terre Haute, Ind.	1904
terstate Public Service Co.	Indianapolis, Ind.	Columbus, Ind.	1909
t'l. Creo. & Con. Co.	Galveston, Tex.	**Beaumont, Tex.**	1892 1897
" " " "	" "	Galveston, Tex.	1905
" " " "	" "	Texarkana, Ark.	1902
nnison-Wright Co.	Toledo, O.	Toledo, O.	1910
ttle River Co.	Minneapolis, Minn.	Madison, Ill.	1909
" " "	" "	Sandstone, Minn.	1904
uisiana Creosoting Co.	Winnfield, La.	Winnfield, La.	1906
& N. R. R. Co.	Louisville, Ky.	Guthrie, Ky.	1913
" " " " "	" "	Gautier, Miss.	1895 1916
s Angeles & S. L. R. R. Co.	Los Angeles, Cal.	Zinc, Cal.	1908
ichigan Pipe Co.	Bay City, Mich.	Bay City, Mich.	1893
ichigan Wood Preserving Co.	Pittsburgh, Pa.	Reed City, Mich.	1913
idland Creosoting Co.	Toledo, O.	Granite City, Ill.	1917
o., Kan & Tex. Ry. Co.	St. Louis, Mo.	Dennison, Tex.	1909
oss Tie Co., T. J.	" " "	Mt. Vernon, Ill.	1899
at'l Lbr. & Creo. Co.	Texarkana, Ark.	Texarkana, Tex.	1910
" " " "	" "	Houston, Tex.	1912
orfolk Creosoting Co.	Norfolk, Va.	**Buell (nr. Norfolk), Va.**	1896 1905
orthern Pacific Ry. Co.	St. Paul, Minn.	Brainerd, Minn.	1907
" " " "	" "	Paradise, Mont.	1907
hio Wood Preserving Co.	Pittsburgh, Pa.	Orrville, O.	1912
regon-Wash. R. R. & Nav. Co.	Portland, Oregon	Wyeth, Oregon	1904
acific Creosoting Co.	Seattle, Wash.	Eagle Harbor, Wash.	1906
ennsylvania R. R. Co.	Philadelphia, Pa.	Mount Union, Pa.	1909
" " "	" "	Greenwich, Phila, Pa.	1910

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Wood-Preserving Plants in United States.—(Concluded)

Managing Company	Headquarters	Location of Plant	Year Built	Retorts: Number	Retorts: Diameter Inches	Retorts: Length Feet
Phila. & Reading Ry.	Port Reading, N. J.	Port Reading, N. J.	1912	2	88	140
Pioneer Lbr. & Creo. Co.	Ensley, Ala.	Ensley, Ala.	1911	1	74	76
Pittsburgh Wood Preserving Co.	Pittsburgh, Pa.	Adelaide, Pa.	1911	1	84	90
Puget Sound Wd. Pres. Co.	Lowell, Wash.	Lowell, Wash.	1895	1	84	117
				1	72	83
				1	72	52
Republic Creosoting Co.	Indianapolis, Ind.	Mobile, Ala.	1906	2	74	130
" " "	" "	Indianapolis, Ind.	1903	1	74	130
" " "	" "	Seattle, Wash.	1916	1	74	130
" " "	Minneapolis, Minn.	Minneapolis, Minn.	1905	2	74	130
St. Helens Creosoting Co.	Portland, Oregon	St. Helens, Oregon	1912	4	84	136
St. Paul & Tacoma Lbr. Co.	Tacoma, Wash.	Tacoma, Wash.	1912	1	84	130
Santa Fe Tie & Lumber Preserving Co.	Topeka, Kan.	Somerville, Tex.	1906	5	74	132
Shreveport Creosoting Co.	Louisville, Ky.	Shreveport, La.	1910	2	84	134
Southern Creosoting Co.	Slidell, La.	Slidell, La.	1879	1	84	150
			1902	2	72	100
Southern Pacific Co.	San Francisco, Cal.	Latham, Oregon	1893	2	72	117
" " "	" " "	West Oakland, Cal.	1887	1	72	108
				1	72	138
" " "	" " "	Los Angeles, Cal.	1907	2	72	112
Southern Paving & Const. Co.	Chattanooga, Tenn.	Pensacola, Fla.	1912	1	72	90
Southern Wood Pres. Co.	Atlanta, Ga.	Atlanta, Ga.	1908	1	72	100
Tenn. C. I. & R. R. Co.	Birmingham, Ala.	Bessemer, Ala.	1909	1	72	65
Texas & N. O. R. R. Co.	Houston, Tex.	Houston, Tex.	1890	5	72	112
Union Pacific R. R. Co.	Omaha, Neb.	Topeka, Kan.	1909	2	73	117
" " "	" "	Laramie, Wyo.	1903	2	73	117
U. S. Gov't Wood Pres. Plant	New Orleans, La.	New Orleans, La.				
U. S. Wood Preserving Co.	New York, N. Y.	Buell (near Norfolk), Va.	1907	2	78	150
Western Wood Pres. Co.	Spokane, Wash.	Yardley, Wash.	1912	1	84	65
Wyckoff Pipe & Creo. Co.	New York, N. Y.	Portsmouth, Va.	1881	4	74	100
Watkins Creosoting Co.	Chicago, Ill.	Metropolis, Ill.	1913	1	74	100

CANADA.

Bruce & Co., Alex.	Glasgow, Scotland	Fort Francis, Ont.	1912	1	84	76
Canada Creosoting Co., Ltd.	Toronto, Ont.	Trenton, Ont.	1913	1	84	134
Dominion Creo. Co., Ltd.	Vancouver, B. C.	Vancouver, B. C.	1910	2	90	100
Dominion Tar & Chem. Co.	Sydney, N. S.	Sydney, N. S.	1911	1	78	85
" " " "	" "	Transcona (nr. Winnipeg), Manitoba	1912	1	78	84
				3	78	135
Vancouver Creosoting Co., Ltd.	Vancouver, B. C.	North Vancouver, B. C.	1916	2	84	132

MEXICO.

No data available regarding treating plants in Mexico. The Mexican Central Railroad built a plant at Aguas Calientas, Mex., in 1901, to treat railroad ties with zinc chloride. About the year 1907 the Madero Co. built a 2-retort plant at Madera, Chihuahua, Mex., to treat railroad ties with zinc chloride.

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WOOD-PRESERVING PLANTS IN UNITED STATES, CANADA AND MEXICO.

UNITED STATES.

NON-PRESSURE PROCESSES.

Managing Company	Headquarters	Location of Plant	Year Built	Tanks or Cylinders: Number	Tanks or Cylinders: Size Feet
Allen & Son Co., Otis	Lowell, Mass.	Lowell, Mass.	1848	2	4x 8x50
" " " " "	" "	Portsmouth, N. H.	1875	4	4x 8x50
Anaconda Copper Mg. Co.	Butte, Mont.	Rocker, Mont.	1909	1	10x10x10
Barnes-Lindsley Mfg. Co.	Portland, Oregon	Portland, Oregon	....	.	.....
Baxter & Jordan	Los Angeles, Cal.	Los Angeles, Cal.	1911	.	.....
Carbolineum Wd. Pres. Co.	Portland, Oregon.	Portland, Oregon	1910	4	3x 4x60
E. T. Chapin Co.	Spokane, Wash.	Bovil, Idaho	1915	2	8x12x11
Del. Lack. & West. R. R. Co.	Scranton, Pa.	Nanticoke, Pa.	1907	1	6 dia. x32
Homestake Mining Co.	Lead, S. D.	Lead, S. D.	1908	1	4 dia. x38
Lindsley Bros. Co.	Spokane, Wash.	Minneapolis, Minn.	1916	2	14x18x11
" " "	" "	Priest River, Idaho	1910	2	5 dia. x11
Milwaukee Ry. & Light Co.	Milwaukee, Wis.	Milwaukee, Wis.	1910	.	.....
Naugle Pole & Tie Co.	Chicago, Ill.	Chicago, Ill.	1912	2	5x 5x10
Pacific Light & Power Co.	Los Angeles, Cal.	Los Angeles, Cal.	1912	3	10.5x8.5x9
Page & Hill Co.	Minneapolis, Minn.	Minneapolis, Minn.	1911	4	6 dia. x11
P. & R. Coal & Iron Co.	Pottsville, Pa.	New Philadelphia, Pa.	1908	1	6 dia. x32
Portland Ry. Light & Power Co.	Portland, Ore.	Portland, Ore.			
Public Service Electric Co.	Newark, N. J.	Newark, N. J.	1909	1	10x32x 2
Puget Sound Wd. P. Co.	Lowell, Wash.	Lowell, Wash.	1895	1	3x10x30
Reeves Co., The	New Orleans, La.	New Orleans, La.	1915	1	3x 3x30
			1910	1	4x 4x30
Republic Creosoting Co.	Mobile, Ala.	Mobile, Ala.	1912	1	3x19x10
San Joaquin L. & P. Co.	Fresno, Cal.	Fresno, Cal.	1910	2	7x 9x 9
St. Paul & Tacoma Lbr. Co.	Tacoma, Wash.	Tacoma, Wash.	1915	4	7x10x30
Southern Pacific Co.	San Francisco, Cal.	West Oakland, Cal.	1911	1	4x 6x 8
U. S. Govt. Wood Pres. Plant	Keokuk, Iowa	Keokuk, Iowa	1908	1	4x 3x42
" " " " "	Milan. Ill.	Milan, Ill.	1908	1	4x 3x42
" " " " "	Stillwater, Minn.	Stillwater, Minn.	1908	1	4x 3x42
" " " " "	Fountain City, Wis.	Fountain City, Wis.	1908	1	4x 3x42
Valentine-Clark Co.	Minneapolis, Minn.	Minneapolis Transfer, St. Paul, Minn.	1908	1	12x14x12
			1908	2	8 dia. x12
Washington Creosoting Co.	Everett, Wash.	Everett, Wash.	1916	4	30x 7x10
Western Cedar Pole Preservers	Spokane, Wash.	Sandpoint, Idaho	1916	2	8x24x11
" " " "	" "	" "	1916	1	5 dia. x11

CANADA.

Lindsley Bros.	Spokane, Wash.	Naskup, B. C.	1910	1	6 dia. x12

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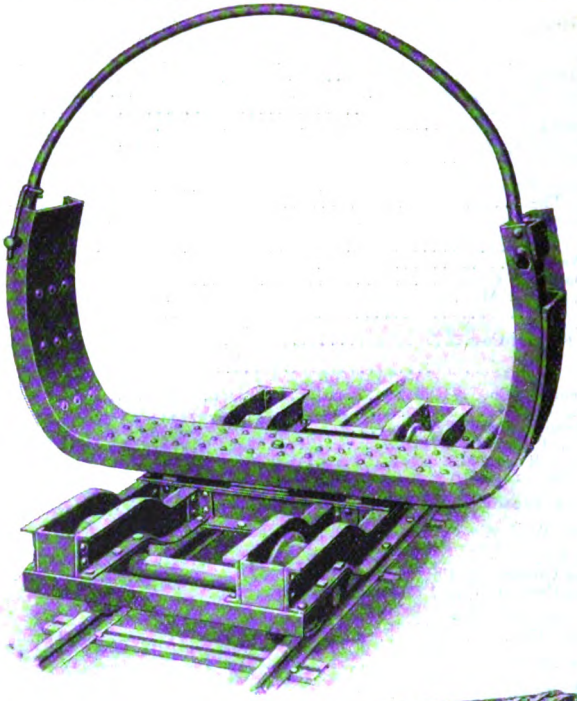

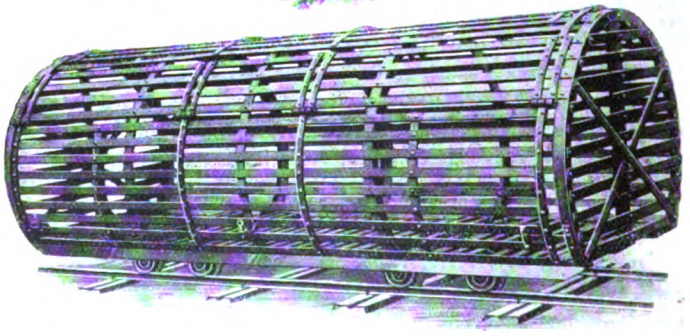

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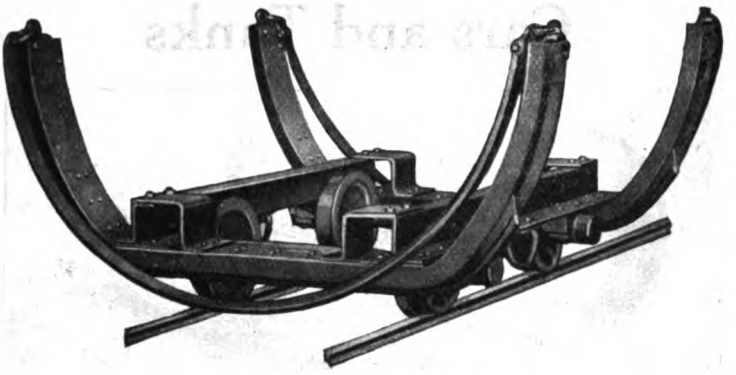

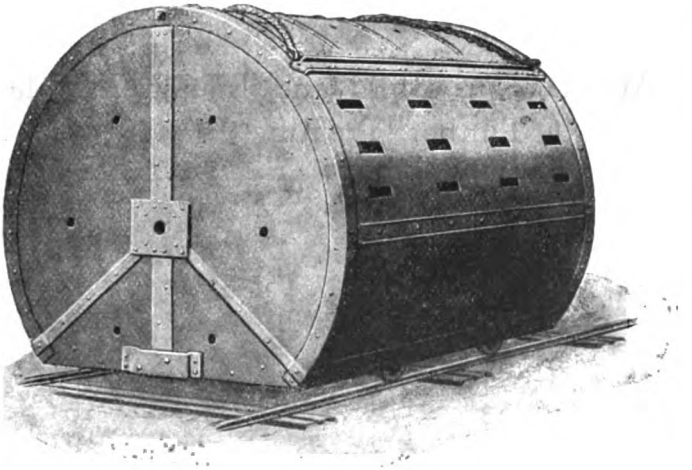

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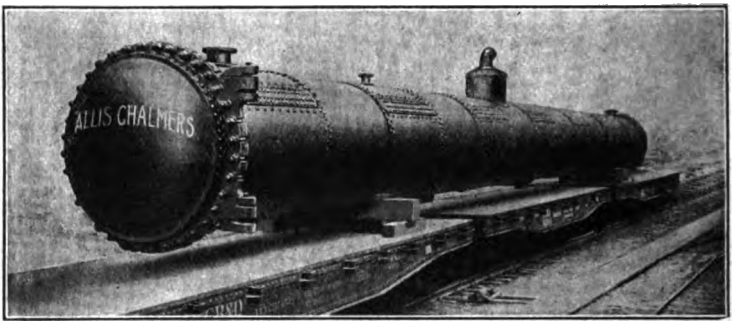

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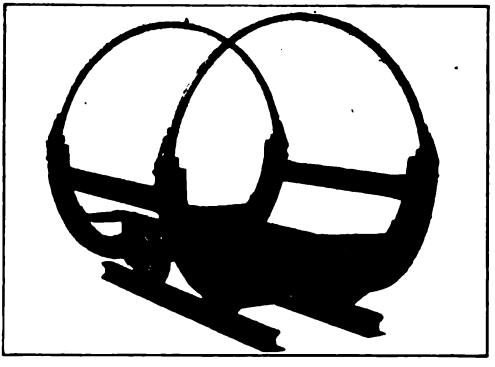

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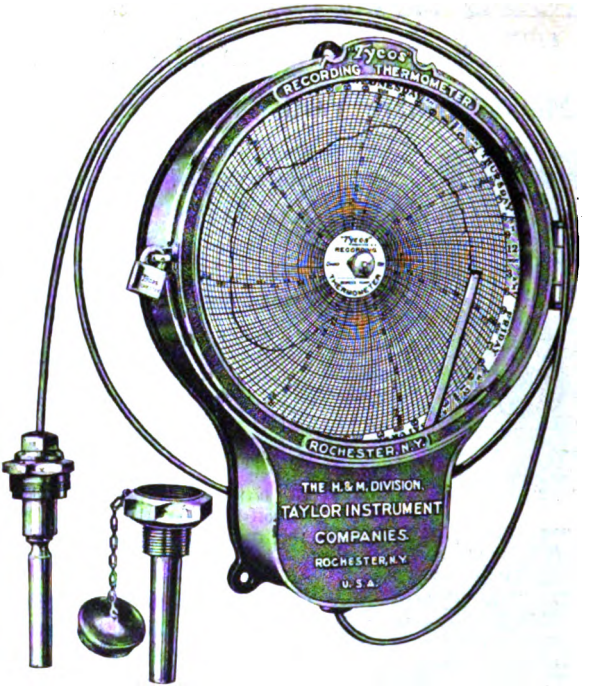
H&M Thermometers



We Know the Needs of Timber Treating

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Every Thermometer bearing H & M Tycos makes honest claim to supremacy, every manufacturing step carefully worked out in detail; industry and application studied.

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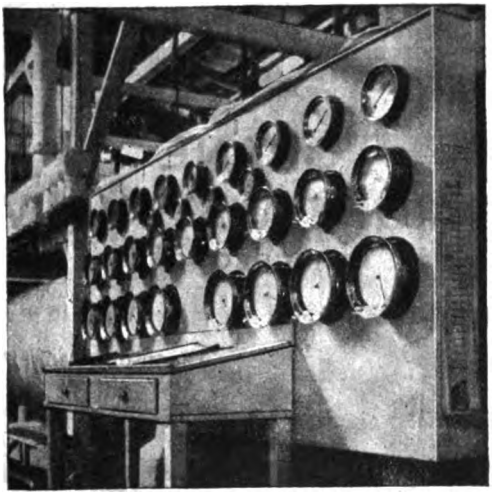

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ONE OF THE LARGEST CREOSOTING PLANTS IN THE UNITED STATES WHICH IS FULLY EQUIPPED WITH

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Our **Automatic Temperature Controller** has many marked improvements that make it especially adaptable, it is worth your investigating.

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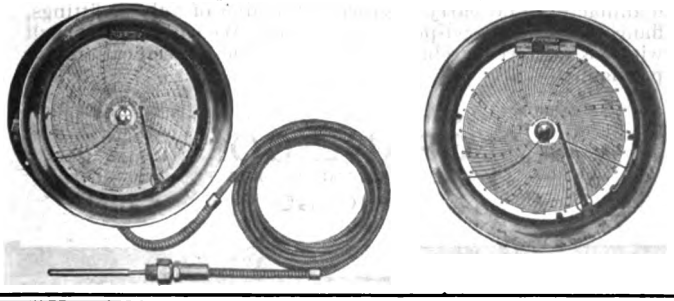

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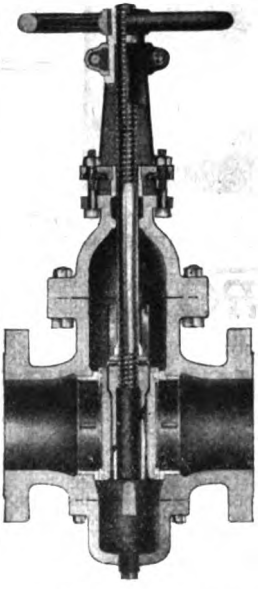
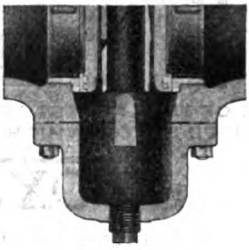
CRANE
STRAIGHT-WAY VALVES
FOR CREOSOTE



With

"Clean-out Pocket"



The clean-out pocket, which is removable, retains sediment, foreign matter, etc. To clean the valve it is unnecessary to remove it from the line or take the valve apart—simply remove Clean-out Pocket; then free access to interior of valve is allowed.

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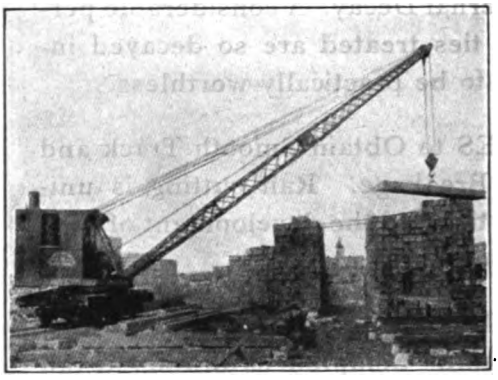

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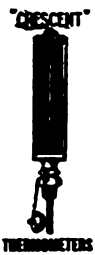

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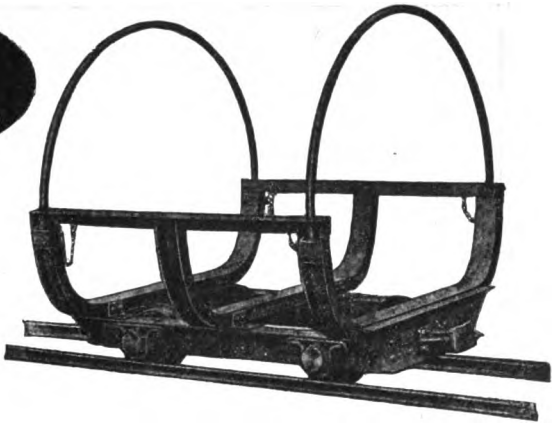

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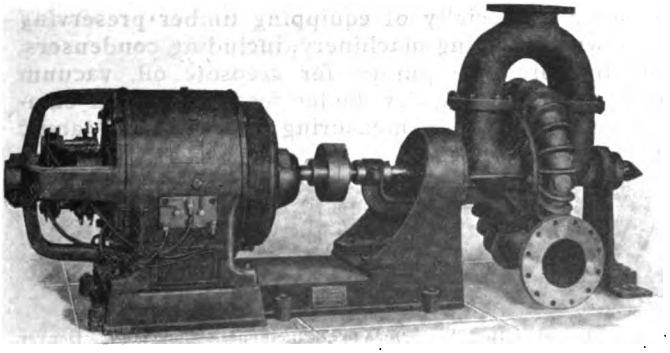

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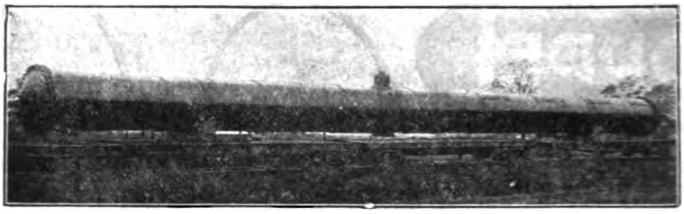

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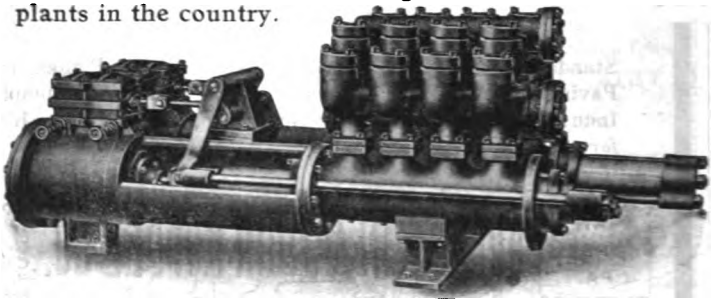

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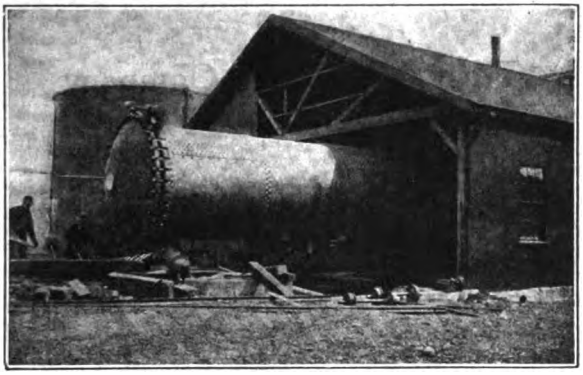

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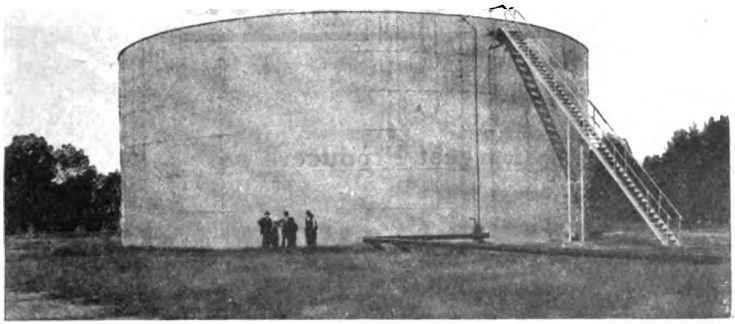

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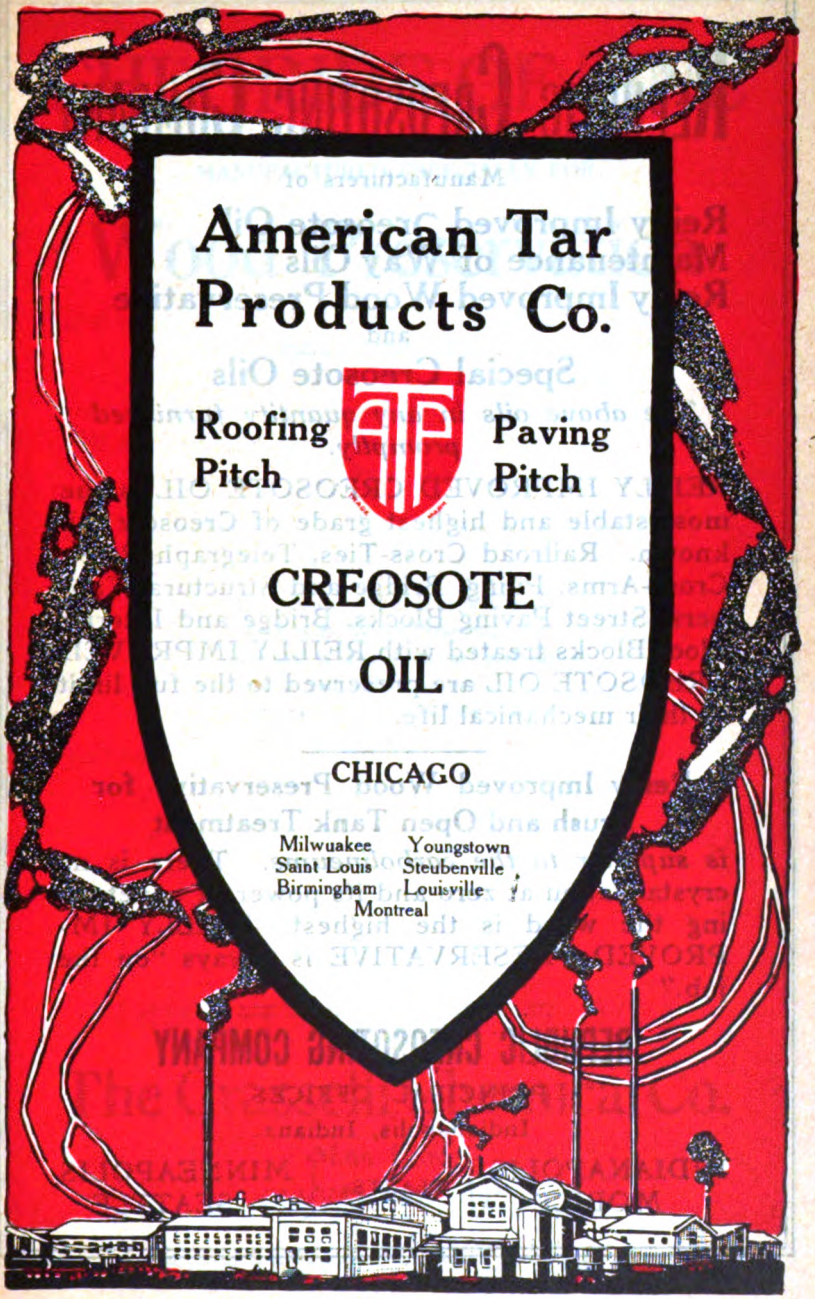

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THE

Fourteenth Annual Meeting

OF THE

American Wood-Preservers' Association

WILL BE HELD IN

CHICAGO, ILL.,

January 22, 23 and 24, 1918

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THE

Fourteenth Annual Meeting

OF THE

American

Blind-Teachers'

Association

AT

CHICAGO, ILL.,

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Fourteenth Annual Meeting

American Wood-Preservers' Association

AT ST. LOUIS, MO.
Nineteen Hundred and Eighteen

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AMERICAN WOOD-PRESERVERS' ASSOCIATION

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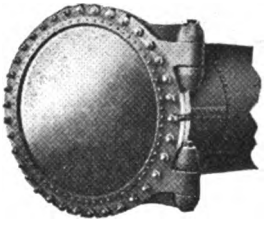
PROCEEDINGS

OF THE

Fourteenth Annual Meeting

OF THE

American Wood-Preservers' Association



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CHICAGO, ILLINOIS

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President, 1918

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AMERICAN WOOD-PRESERVERS' ASSOCIATION

Constitution

(Amended 1912, 1915, 1916)

ARTICLE I.

Name and Objects.

SECTION 1. The name of this Association shall be the AMERICAN WOOD-PRESERVERS' ASSOCIATION.

SECTION 2. The objects of the Association shall be the promotion of knowledge of the materials, methods, and principles involved in the economic design, location, construction, maintenance, and operation of wood-preserving works; the standarization of specifications for wood preservatives and for their introduction into the material to be preserved; and the maintenance of high standards of business ethics in the wood-preserving industry.

SECTION 3. The means to be used for these purposes shall be meetings for the presentation and discussion of reports of the experiences and investigations of its members and others, for the interchange of ideas, and for social intercourse; the publication of desirable information; and co-operation with organizations or individuals in work affecting wood-preserving.

ARTICLE II.

Membership.

SECTION 1. The Association shall consist of Corporate, Associate, Probate, and Honorary members.

SECTION 2. A Corporate Member shall be an executive, an administrator, or an operative in a wood-preserving organization; an officer of a public-utility corporation using treated wood whose duties cover the purchasing, inspecting, treating, or distribution of such material; a chemist or an engineer in the employ of a city, county, state, nation, or public-utility corporaton; a consulting chemical, civil, electrical, forest, or mechanical engineer; or a professor or an instructor in an institution of learning.

SECTION 3. An Associate Member shall be any person or association of persons interested in wood preservation or in the sale of material or equipment used in the wood-preserving industry.

SECTION 4. A Probate Member shall be an employe of a wood-preserving or inspecting organization who is not eligible for Corporate Membership.

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SECTION 5. An Honorary Member shall be a person of acknowledged eminence in the wood-preserving industry or the sciences relating thereto. The number of Honorary Members shall not exceed five.

SECTION 6. Corporate Members shall have all the rights and privileges of the Association.

SECTION 7. Associate Members shall have all the rights of Corporate Members, except those of voting or holding office.

SECTION 8. Probate Members shall have all the rights of Corporate Members, except those of voting or holding office, for five years from the date of their admission, when their status shall be determined by the Executive Committee.

SECTION 9. Honorary Members shall have all the rights of Corporate Members, except that of holding office, and shall be exempt from the payment of dues.

ARTICLE III.

Admissions and Expulsions.

SECTION 1. Applications for membership and resignations from membership shall be transmitted to the Secretary-Treasurer, the former on a form prescribed by the Executive Committee and endorsed by a Corporate or an Honorary Member. The Secretary-Treasurer shall forward a copy of each application for membership to each member of the Executive Committee, the affirmative votes of a majority of whom shall admit the candidate.

SECTION 2. Proposals for Honorary Membership shall be made by at least ten members, none of whom shall be a member of the Executive Committee. The nominee shall be declared an Honorary Member if he receives the unanimous vote of the Executive Committee or the votes of two-thirds of the Corporate and Honorary members.

SECTION 3. Any member of the Association who resigns while in good standing my be reinstated without paying a second admission fee, provided his application is approved by two-thirds of the Executive Committee.

SECTION 4. For unbecoming conduct a member may be expelled by the votes of two-thirds of the members at an Annual Meeting, after the member has been served with written particulars as to his offense by the Executive Committee, and had an opportunity to be heard by it or by the members at an Annual Meeting.

SECTION 5. The Executive Committee shall accept the resignation, tendered in writing of any member whose dues are paid.

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ARTICLE IV.

Dues.

SECTION 1. On admission to the Association, members shall pay fees as follows: Corporate Members, $10.00; Associate Members, $15.00; Probate Members, $5.00, which shall include their first dues.

SECTION 2. The annual dues, payable during the first two months of the calendar year, shall be as follows: Corporate Members, $10.00; Associate Members, $10.00; Probate Members, $5.00.

SECTION 3. Members admitted after March 31 shall be exempt from the payment of dues until the following January 1, unless they desire to vote or to receive the current publications of the Association, in which case they shall pay one-half of the annual dues.

SECTION 4. Any member whose dues are unpaid on April 1 shall not receive the publications of the Association, and if his dues are not paid by December 31, his membership shall be canceled, except as provided for in Section 5 of this Article.

SECTION 5. The Executive Committee may extend the time for paying or remit the dues of any Corporate or Probate members who are unable to pay them.

ARTICLE V.

Officers.

SECTION 1. The officers of the Association shall be Corporate Members and shall consist of a President, a First Vice-President, a Second Vice-President, a Secretary-Treasurer, and six Members of Executive Committee, who, together with the Past-President who is a Corporate Member, shall constitute the Executive Committee in which responsibility for the government of the Association shall be vested. The President shall be chosen from the nine eligible members of the Executive Committee.

SECTION 2. No two or more officers in any year shall be members of the same business organization.

SECTION 3. The President, the First Vice-President, the Second Vice-President, the Secretary-Treasurer, and two members of the Executive Committee shall be elected at each Annual Meeting.

SECTION 4. The terms of the President, Vice-Presidents, and Secretary-Treasurer shall begin at the close of the Annual Meeting at which they are elected and continue until their successors are elected and have qualified. The six Members of Executive Committee shall serve three years, two being elected each year.

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SECTION 5. A vacancy in the office of President shall be filled by the Vice-Presidents in order.

SECTION 6. A vacancy in any office other than that of President shall be filled by an appointee of the Executive Committee.

SECTION 7. The President shall not be eligible for re-election to that office until three others have filled it. A Vice-President shall not be eligible for re-election to the same office until one other has filled it.

ARTICLE VI.

Nomination and Election of Officers.

SECTION 1. At each Annual Meeting six Corporate Members who are not officers shall be elected, together with the three last Past-Presidents who are Corporate Members, to serve one year as a Nominating Committee, of which the senior Past-President shall be chairman.

SECTION 2. The Nominating Committee shall nominate one eligible member for each office and for each membership in the Nominating Committee and shall send its list of nominees to the Secretary-Treasurer before October 15. Any vacancies that may occur in the list of nominees before it is sent to the members shall be filled by the Executive Committee.

SECTION 3. The voting shall not be restricted to the names presented by the Nominating Committee. Any member may file with the Secretary-Treasurer before November 1 the name of a candidate for any office.

SECTION 4. The ballot, with envelopes for secret voting, shall be sent to each member before December 1. It must contain the names of all nominees for each office, arranged alphabetically where there is more than one name for any office, with the nominees of the Nominating Committee plainly indicated.

SECTION 5. Members may scratch or substitute the name of any nominee for any office.

SECTION 6. Ballots shall be sealed and sent or delivered to the Secretary-Treasurer before the polls close, prior to which time a voter may withdraw or replace his ballot.

SECTION 7. The polls shall be closed at noon on the first day of the Annual Meeting, and the ballots shall be counted by one Corporate and four Associate or Probate Members, appointed tellers by the presiding officer at the Annual Meeting.

SECTION 8. The persons who receive the highest number of votes for the offices for which they are candidates shall be declared elected. In case of a tie between candidates for the same office, the members pres-

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ent at the Annual Meeting shall elect the officer from the candidates so tied. The presiding officer shall announce to the meeting the names of the officers elected.

ARTICLE VII.

Management.

SECTION 1. The President shall have general supervision of the affairs of the Association, shall preside at its meetings and those of the Executive Committee, and shall be a member *ex-officio* of every committee except the Nominating Committee.

SECTION 2. The Vice-Presidents, in order of seniority, shall preside at meetings in the absence of the President, and discharge his duties in case of a vacancy in the office.

SECTION 3. The Secretary-Treasurer, under the direction of the President and the Executive Committee, shall be the executive officer of the Association. He shall conduct the correspondence of the Association; record the proceedings of all meetings; collect and deposit all moneys due the Association; verify all bills and pay them when approved by the President or Executive Committee; make at each Annual Meeting a report of the accounts and membership of the Association; and perform such other duties as may be assigned to him by the Executive Committee.

SECTION 4. The Executive Committee shall manage the affairs of the Association, and shall have full power to control and regulate all matters not provided for in the Constitution. It shall act on applications for membership; make appropriations for specific purposes; direct the care of the surplus funds of the Association; and audit the accounts of the Secretary-Treasurer.

SECTION 5. The Executive Committee shall publish the activities of the Association in a book to be known as the Annual Proceedings; but, subject to the action of the Association, it may withhold, in whole or in part, discussions, papers, or reports, the propriety or soundness of which it considers questionable.

SECTION 6. The Executive Committee shall have printed a Manual of Recommended Practice, in which shall be published the specifications and standards approved by the Association in accordance with Article X.

SECTION 7. The Executive Committee shall meet at such times and places as the President may direct, or five members may request in writing. Six members shall constitute a quorum.

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ARTICLE VIII.

Meetings.

SECTION 1. An Annual Meeting, at which the officers shall be elected and all annual reports read, shall be held on the fourth Tuesday in January of each year, at ten o'clock A. M., at such place as the Association at the previous meeting may designate.

SECTION 2. Whenever the President may deem it necessary, or upon the written application of fifteen Corporate Members, he shall direct the Secretary-Treasurer to call a special meeting. The call for such a meeting shall state the time, place, and purpose of the meeting, and shall be mailed not less than thirty days prior to the date of the proposed meeting.

SECTOIN 3. Twenty Corporate Members shall constitute a quorum at any meeting of the Association.

SECTION 4. The order of business at the meetings of the Association shall be arranged by the Executive Committee, subject to addition or change by the votes of the majority of the members present.

ARTICLE IX.

Amendments.

SECTION 1. Proposed amendments to this Constitution must be offered in writing, signed by at least five Corporate Members, and forwarded to the Secretary-Treasurer not less than thirty days prior to the Annual Meeting. They shall be published with the notices for the meeting.

SECTION 2. Proposed amendments shall be in order for discussion at the Annual Meeting, and may be amended and adopted if two-thirds of the votes of the Corporate and Honorary members present and voting are affirmative.

ARTICLE X.

Adoption of Standards.

SECTION 1. Any proposals for the approval or recommendation by the Association, of definitions, methods, nomenclature, specifications, standard construction, or standard practice, or aimed at defining formally the position of the Association on any matter of importance, shall be presented in writing, with drawings if necessary, at an Annual Meeting. At this meeting amendments may be made by a majority of the Corporate and Honorary Members present and voting. Proposed standards shall be referred to letter ballot of the Association if two-thirds of the Corporate and Honorary Members at an Annual Meeting vote affirmatively. The affirmative votes of two-thirds of all Corporate and Honorary members shall be required for the adoption of any standard.

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Past and Present Officers of the American Wood-Preservers' Association.

Number	Year Elected.	President.	First Vice-President	Second Vice-President	Third Vice-President	Secretary-Treasurer
1st.....	1905	J. S. Baker	C. B. Lowry†	H. J. Whitmore†	F. A. Kummer*	C. W. Berry
2nd.....	1906	C. B. Lowry†	E. O. Faulkner	Edmund Christian	David Allerton	C. W. Berry
3rd.....	1907	C. B. Lowry†	David Allerton	Walter Buehler	H. S. Valentine	C. W. Berry
4th.....	1908	Walter Buehler	C. B. Lowry†	David Allerton	H. S. Valentine	C. W. Berry
5th.....	1909	Walter Buehler	David Allerton	H. S. Valentine	H. M. Rollins	C. W. Berry
6th.....	1910	Walter Buehler	C. W. Berry	David Allerton	C. D. Chanute†	F. J. Angier
7th.....	1911	John T. Logan	Andrew Gibson	R. J. Calder	D. Burkhalter	F. J. Angier
8th.....	1912	E. A. Sterling	A. M. Smith	H. M. Rollins	G. B. Shipley	F. J. Angier
9th.....	1913	A. E. Larkin	J. H. Waterman	E. B. Fulks	Geo. E. Rex	F. J. Angier
10th.....	1914	Geo. E. Rex	Carl G. Crawford	R. S. Manley	F. B. Ridgway*	F. J. Angier
11th.....	1915	J. H. Waterman	H. S. Loud	Lowry Smith	F. D. Beal	F. J. Angier
12th.....	1916	Carl G. Crawford	John Foley	M. K. Trumbull	.....	F. J. Angier
13th.....	1917	John Foley	M. K. Trumbull	J. B. Card	.....	F. J. Angier
14th.....	1918	M. K. Trumbull	J. B. Card	A. R. Joyce	.....	F. J. Angier

†Deceased. *Resigned.

In 1915 the Executive Committee was increased to 11 members, the 6 additional members to serve from 1 to 3 years. In 1916 the office of Third Vice-President was abolished.

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Meetings.

Year.	City.	Hotel.	Members Present.	Visitors Present.	Number of Pages in Proceedings.	Number of Papers and Reports Presented.
1905.....	New Orleans	St. Charles	15	No record	37	7
1906.....	Chicago	Palmer House	16	No record	56	9
1907.....	Memphis	Baltimore	16	No record	64	10
1908.....	Kansas City	Gayoso	No record	No record	Not issued	..
1909.....	Chicago	Audotorium	..	100	141	12
1910.....	Chicago	Audotorium	24	74	190	14
1911.....	Chicago	Audotorium	50	70	302	20
1912.....	Chicago	Sherman	67	..	348	17
1913.....	Chicago	Sherman	83	36	525	22
1914.....	New Orleans	St. Charles	65	43	544	25
1915.....	Chicago	Congress	122	105	527	23
1916.....	Chicago	Sherman	115	89	432	31
1917.....	New York	Astor	100	133	538	26
1918.....	Chicago	Sherman	83	51	262	22

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OFFICERS.

M. K. Trumbull.....President
J. B. Card.....First Vice-President
A. R. Joyce.....Second Vice-President
F. J. Angier.....Secretary-Treasurer

EXECUTIVE COMMITTEE.

M. K. Trumbull, *Chairman*

Business.
C. Marshall Taylor, *Chairman*
F. J. Angier
John Foley
E. B. Fulks
Geo. E. Rex

Education.
E. T. Howson, *Chairman*
J. B. Card
V. K. Hendricks
A. R. Joyce
F. S. Pooler

Committee No. 1—Meeting.

A. R. Joyce, *Chairman*

Program.
A. R. Joyce, *Chairman*
E. T. Howson
F. S. Pooler
Geo. E. Rex

Entertainment.
E. E. Pershall, *Chairman*
A. L. Kammerer
L. B. Moses
H. M. Newton
P. R. Walsh

Committee No. 2—Publications.

John Foley, *Chairman*
E. J. Allen
E. T. Howson
T. A. Lawton
G. A. Lembcke
F. S. Pooler
L. B. Shipley

Committee No. 3—Promotion and Education.

Carl G. Crawford, *Chairman*
J. S. Bates
N. C. Brown
F. V. Dunham
F. J. Hoxie
S. J. Record
C. C. Schnatterbeck
O. T. Swan
J. H. Waterman

Committee No. 4—Service Tests.

P. R. Hicks, *Chairman*

Ties and Timber.
J. H. Waterman, *Chairman*
E. O. Faulkner
W. H. Fulweiler
F. D. Mattos
H. von Schrenk

Flooring and Paving.
A. W. Dow, *Chairman*
Walter Buehler
E. R. Dutton
L. T. Ericson
H. S. Loud

Committee No. 5—Plant Operation.

W. H. Grady, *Chairman*
E. E. Alexander
W. L. Bacon
H. B. Hoyt
August Meyer
J. S. Penney
M. M. Rabourn

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Committee No. 6—Preservatives.

E. B. Fulks, *Chairman*

S. R. Church
C. E. Gosline
A. L. Kammerer
O. C. Steinmayer
F. W. Kroemer

Committee No. 7—Purchase and Preservation of Treatable Timber.

H. S. Sackett, *Chairman*

Kurt C. Barth
F. V. Dunham
W. W. Lawson
F. R. Martin
M. T. Shanesey
Lowry Smith
H. S. Valentine

Committee No. 8—Wood-Block Flooring and Paving.

Walter Buehler, *Chairman*

F. W. Cherrington
F. P. Hamilton
A. L. Kuehn
H. M. Newton
A. Stamford
C. H. Teesdale

Committee No. 9—Terminology.

Wm. A. Fisher, *Chairman*

F. J. Angier
Carl G. Crawford
F. N. Graham
J. H. Grow

Committee No. 10—Non-Pressure Treatments.

R. A. Griffin, *Chairman*

W. M. Carpenter
E. T. Chapin
L. L. Hill
R. F. Hosford

Committee No. 11—War Service and Conference.

John Foley, *Chairman*

E. T. Howson
Geo E. Rex

Committee No. 12—Nominating.

J. H. Waterman, *Chairman*

E. H. Bowser
Walter Buehler
Carl G. Crawford
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John Foley
C. F. Ford
G. B. Shipley
O. C. Steinmayer

NOTICE—The Association is not responsible as a body for the opinions expressed by individuals.

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MEMBERS.

c-Corporate. a-Associate. p-Probate. h-Honorary.
Figures indicate serial number of Membership Certificates.

324 c ACREE, S. F.....Syracuse University, Syracuse, N. Y.
384 c ADAMS, CHARLES.....Supt., Wood-Preserving Works, Southern Pacific Co., Cottage Grove, Oregon.
183 c ALEXANDER, E. E.....Supervisor of Plants, Baltimore & Ohio R. R., Green Spring, W. Va.
29 c ALLARDYCE, R. L.....Supt., International Creosoting & Construction Co., Texarkana, Texas.
360 a ALLEN, E. J.....Ties and Lumber, 32 Broadway, New York.
21 c ALLERTON, DAVID.....
1 c ANGIER, F. J.....Supt. of Timber Preservation, Baltimore & Ohio R. R., Baltimore, Md.
105 c BACON, W. L.....Supt., Tie-Treating Plant, C. & N. W. Ry., Escanaba, Mich.
3 h BAKER, J. S.....Box 22, Paducah, Ky.
379 a BARTH, KURT C.....Specialist, Non-Pressure Treatments, The Barrett Co., 332 So. Ridgeland Ave., Oak Park, Ill.
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4 c BEAL, F. D.....Engineer, 414 Insurance Exchange Bldg., San Francisco, Cal.
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22 c BOEHNE, E. E.....Mgr., Sales Department, International Creosoting & Construction Co., Galveston, Tex.
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368 a BREYER, FRANK G.....Chief of Research Department, New Jersey Zinc Co., Palmerton, Pa.
230 c BROWN, NELSON C.....Trade Commissioner, U. S. Lumber Trade Commission, Department of Commerce, Washington, D. C.
377 a BROWN, S. K.....U. S. A.
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388 a CALVIN, R. A.....Mgr., Oil Department, The Kettle River Co., 1111 Plymouth Bldg., Minneapolis, Minn.
190 c CAMPBELL, J. H.....Chemical Engineer, R. W. Hunt & Co. 2200 Insurance Exchange, Chicago, Ill.
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69 c CHERRINGTON, F. W.....Chief Engineer, The Jennison-Wright Co., 331 Huron St., Toledo, O.
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386 c CLARKE, ROY C.....Inspector, Pittsburgh & Lake Erie R. R., Adelaide, Pa.
184 c CLARK, W. DENNISON.....Vice-Prest. and Gen. Mgr., Columbia Creosoting Co., 810 Lewis Bldg., Portland, Oregon.
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319 p CLEMENTS, CYRIL M.....U. S. A.
385 a CLIFFORD, W. E.....Chemical Engineer, Forest Products Chemical Co., Memphis, Tenn.
174 c CLIFTON, W. H.....Lumber Agent, Baltimore & Ohio R. R., Baltimore, Md.
249 c COBEAN, CHAS. E.....Supt., Pacific Creosoting Co., Creosote, Wash.
188 a COCKE, W. H.....U. S. A.
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178 c DUNSTAN, J. H.....Supt., Southern Creosoting Co., Slidell, La.
211 c DURHAM, J. H.....Vice-Prest., American Creosoting Co., Louisville, Ky.
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9 h FAULKNER, E. O.....Mgr., Tie & Timber Department, Atchison, Topeka & Santa Fe Ry., Kerckhoff Bldg., Los Angeles, Cal.
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314 a NIXON, WARREN C.....U. S. N.
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227 c PERRY, ARTHUR W.....Night Gen. Foreman, Santa Fe Tie & Lumber Preserving Co., Somerville, Tex.
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197 c TOWNSEND, T. G.....U. S. A.
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65 c VAN METRE, RICKER.....Vice-Prest., Joyce-Watkins Co., 332 S. Michigan Ave., Chicago, Ill.
207 a von BERNUTH, OSCAR.....Prest., Lembcke, von Bernuth Co., 171 Madison Ave., New York.
141 c von LEER, H. J.....U. S. A.
46 c von SCHRENK, DR. H.....Consulting Timber Engineer, Tower, Grove & Flad Aves., St. Louis, Mo.
378 c VORUM, A. H.....Inspection Engineer, Western Electric Co., 195 Broadway, New York.
326 c WADDELL, KENNETH M.....U. S. A.
256 c WALLACE, H.....Supt., Canada Creosoting Co., Ltd., Trenton, Ontario, Canada.
111 a WALSH, P. R.....Prest., Walsh-Griffith Tie & Lumber Co., 718 Title Guaranty Bldg., St. Louis, Mo.
81 c WATERMAN, J. H.....Supt. of Timber Preservation, Chicago, Burlington & Quincy R. R., Galesburg, Ill.
150 c WATKINS, W. T.....Prest., Joyce-Watkins Co., 332 S. Michigan Ave., Chicago, Ill.
387 c WEATHERLY, J. L.....Cross-Tie Sales, The Kettle River Co., 1111 Plymouth Bldg., Minneapolis, Minn.
134 c WEBER, J. M.....Supt., Ohio Wood Preserving Co., Orrville, O.
305 a WEGENER, RICHARD.....Prest., Standard Tar Products Co., 627 27th St., Milwaukee, Wis.
79 h WEISS, HOWARD F.....Consulting Engineer, C. F. Burgess Laboratory, Madison, Wis.
177 c WHITE, THOS. M.....U. S. N.

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47 c WILLIAMS, J. C.....U. S. A.
138 c WILLIAMS, R. R.....Prest. & Treas., Indiana Tie Co., Citizens National Bank Bldg., Evansville, Ind.
102 b WINSLOW, CARLILE P.....Director, Forest Products Laboratory, Madison, Wis.
298 c WRIGHT, W. E.....Toledo, O.

344 c ZELLER, W. C.....Supt., American Creosoting Co., Newark, N. J.

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CLASSIFICATION OF MEMBERSHIP.

Railroads.

ATCHISON, TOPEKA & SANTA FE:
Belcher, R. S.
Brennan, T. S.
Colliver, S. R.
Cooper, S. D.
Faulkner, E. O.
Jackson, W. E.
Keig, J. R.
Kroemer, F. W.
Perry, A. W.
Rex, Geo. E.

BALTIMORE & OHIO:
Alexander, E. E.
Angier, F. J.
Clifton, W. H.
Rowland, J. W.
Schnatterbeck, C. C.
Stimson, Earl

BOSTON ELEVATED:
Bright, E. W.

BUFFALO, ROCHESTER & PITTSBURGH:
Bens, F. A.
Hoyt, H. B.

CANADIAN PACIFIC:
Dixon, J. H.

CENTRAL OF GEORGIA:
Stewart, F. H.

CHICAGO, BURLINGTON & QUINCY:
Haggander, G. A.
Meyer, A.
Waterman, J. H.

CHICAGO & EASTERN ILLINOIS:
Martin, F. R.

CHICAGO GREAT WESTERN:
Graham, Floyd N.

CHICAGO, INDIANAPOLIS & LOUISVILLE:
Kent, A. S.
Roth, E. J.
Stull, T. G.

CHICAGO, MILWAUKEE & ST. PAUL:
Pinson, J. F.
Pooler, F. S.
Sackett, H. S.

CHICAGO & NORTHWESTERN:
Bacon, W. L.
Davidson, Geo. M.

CHICAGO, ROCK ISLAND & PACIFIC:
Ford, C. F.
Paul, H. A.

DELAWARE, LACKAWANNA & WESTERN:
Goeline, C. E.

EL PASO & SOUTHWESTERN:
Ross, P. A.

ERIE:
Drinker, W. W.
Underwood, F. D.

FRISCO LINES:
Hendricks, V. K.
Steinmayer, O. C.

ILLINOIS CENTRAL:
Bowser, E. H.

LOUISVILLE & NASHVILLE:
Lindsey, John B., Jr.

MILWAUKEE ELECTRIC RWY. & LIGHT:
Stearns, R. B.

MISSOURI, KANSAS & TEXAS:
Noyes, Geo. W.
Smith, W. J.

MISSOURI PACIFIC:
Hammack, M. D.

NEW YORK CENTRAL:
Bury, R. A.
Dixon, G. C.
Shanessey, M. T.

NORTHERN PACIFIC:
Gibson, Andrew
Smith, Lowry

OREGON-WASHINGTON R. R. & NAVIGATION:
Pestel, A. C.

PENNSYLVANIA:
Chilcoat, G. W.
Foley, John
Hopkins, H. W.

PHILADELPHIA & READING:
Taylor, C. M.

PITTSBURGH & LAKE ERIE:
Clarke, Roy C.

ST. LOUIS-SAN FRANCISCO:
Hendricks, V. K.

SAN PEDRO, LOS ANGELES & SALT LAKE:
Schuls, Harry

SHEFFIELD & TIONESTA:
Collins, E. S.

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Railroads.—(Continued.)

SOUTHERN:
Finke, W. F. H.
McCartney, Alvin
Tilley, C. M.

SOUTHERN PACIFIC:
Adams, Charles
Isaacs, John D.
Mattos, F. D.

TEXAS & NEW ORLEANS:
Lawson, W. W.

UNION PACIFIC:
Johnson, J. A.

WISCONSIN & NORTHERN:
Hartley, C. H.

Navigation Companies.

NEW ORLEANS-CUBA STEAMSHIP CO.:
Powell, E. L.

Commercial Treating Plants.

AMERICAN CREOSOTING CO. (Louisville, Ky.):
Crawford, C. G.
Durham, J. H.
Grady, W. H.
Hert, A. T.
Moore, R. H.
Taylor, Thos. B.

AMERICAN CREOSOTING CO., N. J.:
Draper, E. G.
Manion, Keron
Zeller, W. C.

AMERICAN CREOSOTE WORKS:
Labrot, S. W.

ATLANTIC CREOSOTING & WOOD PRESERVING WORKS:
Parrott, R. D.

AYER & LORD TIE CO.:
Lord, Russell
Noyes, A. H.
Smith, A. M.

BARBER ASPHALT PAVING CO.:
Forrest, Chas. N.

BURT, BOULTON & HAYWOOD, LTD.:
Fergusson, Hubert

CANADA CREOSOTING CO.:
Look, Richard V.
Wallace, H.

CARBOLINEUM WOOD PRESERVING CO.:
Hartman, E. F.

CENTRAL CREOSOTING CO.:
Card, J. B.
Stocking, E. J.

COLMAN, THE J. M. CO.:
Colman, Geo. A.

COLUMBIA CREOSOTING CO.:
Clark, W. Dennison
Green, D. W.

COMPRESSED WOOD PRESERVING CO.:
Frey, Geo. W.

CONTINENTAL TIE & LUMBER CO.:
Schomberg, T. A.

DOMINION TAR & CHEMICAL CO.
Smith, E. Bernard

EPPINGER & RUSSELL CO.:
Chadwick, Charles S.
Eppinger, Jesse I.
Valentine, H. S.

FOREST PRODUCTS CHEMICAL CO.:
Clifford, W. E.

GULFPORT CREOSOTING CO.:
Fant, A. E.
Rollins, H. M.

INDIANA TIE CO.:
Cecil, Wm. A.
Williams, R. R.

INDIANA ZINC-CREOSOTING CO.:
McArdle, Frank

INTERNATIONAL CREOSOTING & CONSTRUCTION CO.:
Allardyce, R. L.
Boehne, E. E.
Calder, R. J.

JENNISON-WRIGHT CO.:
Cherrington, F. W.
Dresser, Geo. L.
Drinker, L. P.
Ericson, L. T.
Jennison, H. G.
Luck, Geo. L.

JOYCE-WATKINS CO.:
Joyce, A. R.
Van Metre, R.
Watkins, W. T.

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Commercial Treating Plants.—(Continued.)

KETTLE RIVER CO.:
Calvin, R. A.
Weatherly, J. L.

LOUISIANA CREOSOTING CO.:
La Grone, J. M.

MICHIGAN WOOD PRESERVING CO.:
Fisher, Wm. A.
Johnston, John W.
Shipley, David B.
Shipley, Grant B.

MIDLAND CREOSOTING CO.:
Newton, H. M.

MOSS T. J. TIE CO.:
Fristoe, J. W.
Pershall, E. E.
Rabourn, M. M.

NATIONAL LUMBER & CREOSOTING CO.:
Harris, Page
Logan, John T.
Trumbull, M. K.

NAUGLE POLE & TIE CO.:
Morier, L. E.

NORFOLK CREOSOTING CO.:
Smith, P. A.

OHIO WOOD PRESERVING CO.:
Fisher, Wm. A.
Park, E. S.
Shipley, Grant B.
Weber, J. M.

PACIFIC CREOSOTING CO.:
Cobean, Chas. E.
Horricks, H. E.
Thomas, M. A.

PIONEER LUMBER & CREOSOTING CO.:
Russell, H. C.

PITTSBURGH WOOD PRESERVING CO.:
Conway, John L.
Fisher, Wm. A.
Shipley, Grant B.
Stockdale, J. S.

REPUBLIC CREOSOTING CO.:
Batson, C. D.
Larkin, A. E.
Rufli, H. M.
Shuford, C. S.

ST. HELENS CREOSOTING CO.:
Fairley, R. H.

ST. PAUL & TACOMA LUMBER CO.:
Griggs, E. G.
Lane, C. E.

SOUTHERN CREOSOTING CO.:
Dunstan, J. H.

SOUTHERN WOOD PRESERVING CO.:
Meredith, W. C.

UNITED GAS IMPROVEMENT CO.:
Fulweiler, W. H.

UNITED STATES WOOD PRESERVING CO.:
Clements, A. B.
Clements, Cyril M.
Stamford, A.

VANCOUVER CREOSOTING CO.:
Hermann, Geo. E.

WATKINS CREOSOTING CO.:
Helson, J. R.

Tie and Timber Companies.

ALLEN, E. J.

AMERICAN LINE MATERIALS CO.:
Carpenter, W. M.

AMERICAN TIE & TIMBER CO.:
Brown, S. K.

CHAPIN, E. T. CO.:
Chapin, E. T.

CREOSOTED BLOCK PAVING CO.:
Boyd, J. L.
Lattimore, C. H.

CANADIAN TIE & LUMBER CO.:
McCandlees, S. F.

COMPANIA MADERERA DE LA SIERRA DE DURANGO:
Beaty, R. Ernest

CREOSOTED MATERIALS CO.:
Hamilton, F. P.
Manley, R. S.

ELLIOTT, J. A. TIE CO.:
Elliott, J. A.

GOLTRA, W. F. TIE CO.:
Goltra, W. F.

JOHNSON, B. & CO.:
Johnson, J H.

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Tie and Timber Companies.—(Continued.)

LEE, HOBART, TIE CO.:
Lee, Robert E.

LONG-BELL LUMBER CO.:
Parminter, L. I.

McCORMICK, CHAS. R. & CO.:
Beal, F. D.

MITSUI & CO.:
Teshima, Tomotake

NATIONAL POLE CO.:
Griffin, R. A.
Sporley, Chas. M.

PAGE & HILL CO.:
Hill, L. L.

RAILWAY TIE TREATING CO.:
Loud, H. S.

RODD CO., THE:
Rodd, Thos., Jr.

SIGNOR TIE CO.:
Signor, Geo. W.

VALENTINE-CLARK CO.:
Furlong, L. A.

WALSH-GRIFFITH TIE & LUMBER CO.:
Walsh, R. P.

WESTERN TIE & LUMBER CO.:
Nixon, E. A.
Nixon, Warren C.

Chemical and Other Manufacturing Companies.

ALLIS-CHALMERS MFG. CO.:
Grow, J. H.

AMERICAN TAR PRODUCTS CO.:
Fulks, E. B.
Kuehn, A. L.

BARRETT CO., THE:
Barth, Kurt C.
Buehler, Walter
Church, S. R.
Shipley, L. B.

BERK, F. W. & CO.:
Berk, P. F.

CABOT, SAMUEL, INC.:
Cabot, Samuel

CHATFIELD MFG. CO.:
Sjodahl, H. A.

CLARK BROS. CO.:
Reid, Jos. S.

COMMERCIAL ACID CO.:
Cocke, W. H.

CRANE CO.:
Fenn, F. D.

GENERAL CHEMICAL CO.:
Hawkes, A. W.
Stahl, K. F.

GRASSELLI CHEMICAL CO.:
Drefahl, L. C.

GREENLEE BROS. & CO.:
Lounsbury, Jas. A.

LEMBCKE, von BERNUTH CO.:
Lembcke, G. A.
von Bernuth, Oscar

LEWIS, F. J. MFG. CO.:
Lewis, F. J.
Lewis, Wm. H.
Murphy, Wm. B.

LOCKETT, A. M. CO.:
Lockett, A. M.

LUND, C. A. & CO.:
Lund, C. A.

MONSANTO CHEMICAL WORK:
Queeny, John F.

NEW JERSEY ZINC CO.:
Breyer, Frank G.

NORTHEASTERN CO., THE
Eastwick, Chas. H.

ROCMAC CO., THE
Townsley, Wm., Jr.

ROESSLER & HASSLACHER CHEMICAL CO.:
Foersterling, Hans

SEATTLE ENGINEERING CO.:
Dovey, J. T.

STANDARD OIL CO.:
Smith, R. G.

STANDARD TAR PRODUCTS CO.
Wegener, Richard

WESTERN SILO CO.:
Martin, James R.

ZELNICKER, WALTER A., SUPPLY CO.:
Moses, L. B.

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Chemists, Consulting Engineers, Inspectors, Etc.

Allerton, David
Baker, J. S.
Becker, A. C.
Berry, C. W.
Campbell, J. H.
DeCew, J. A.
Demuth, R. E.
Dow, Allan W.
Emerson, Harrington
Higgins, Chas. C.
Judge, F. B.
Kammerer, A. L.
Kendrick, J. W.
Martin, Lyman C.
Murchie, W. E.
Quincy, R. B.
Roberts, G. G.
Silvester, E. L.
Smith, Francis P.
Smith, Phil R.
Smith, V. C.
von Schrenk, Dr. Hermann
Weiss, Howard F.
Wright, W. E.

Governments.

UNITED STATES:

FOREST SERVICE—
Hicks, P. R.
Hunt, Geo. M.
Teesdale, Clyde H.
Winslow, Carlile P.

DEPT. OF COMMERCE—
Brown, Nelson C.

ARMY—
Black, J. M.
Brown, S. K.
Burkhalter, D.
Card, J. B.
Clarke, G. S.
Clements, Cyril M.
Cocke, W. H.
Dovey, J. T.

ARMY—Continued
Fowler, J. W.
Fritz, C. C.
Goss, O. P. M.
Hess, L. E.
Ingalls, E. E.
Lindley, S. B.
Lord, Russell
Rawson, R. H.
Myerly, J. R.
Townsend, T. G.
von Leer, H. J.
Waddell, K. M.
White, T. M.
Williams, J. C.

NAVY—
Draper, E. G.
Everhart, L. H.
Manley, R. S.
Nixon, W. C.

Educational Institutions.

FOREST RESEARCH INSTITUTE AND COLLEGE, INDIA:
Pearson, Ralph S.

McGILL UNIVERSITY, CANADA:
Bates, John S.

YALE UNIVERSITY:
Record, Samuel J.

Associations.

AMERICAN FORESTRY ASSOCIATION:
Ridsdale, P. S.

NORTHERN HEMLOCK & HARDWOOD MANUFACTURERS' ASSOCIATION:
Swan, O. T.

SOUTHERN PINE ASSOCIATION:
Dunham, F. V.

Firms Not Classified.

AMERICAN TELEPHONE AND TELEGRAPH CO.:
Hosford, R. F.

ASSOCIATED FACTORY MUTUAL FIRE INSURANCE COMPANIES:
Hoxie, F. J.

RAPSON COAL MINING CO.:
Curtis, W. W.

WESTERN ELECTRIC CO.:
Sexton, C. H.
Vorum, A. H.

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Municipalities.

DETROIT, MICH.:
Black, James M.

MINNEAPOLIS, MINN.:
Davies, E. T.
Dutton, Ellis R.

NEW YORK, N. Y.:
Ray, John R.

PHILADELPHIA, PA.:
Goldstein, H. I.

SEATTLE, WASH.:
Orumm, Edmund O.

TORONTO, CANADA:
Marriott, F. G.

Periodicals.

"AMERICAN FORESTRY":
Ridsdale, P. S.

"RAILWAY MAINTENANCE ENGINEER":
Howson, E. T.

"WOOD-PRESERVING":
Schnatterbeck, Chas. C.

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ATTENDANCE AT FOURTEENTH ANNUAL MEETING.

Members.

Alexander, E. E.
Angier, F. J.
Bacon, W. L.
Becker, A. C.
Boehne, E. E.
Bowser, E. H.
Buehler Walter
Calvin, R. A.
Campbell, J. H.
Carpenter, W. M.
Cherrington, Frank W.
Church, S. R.
Clarke, Roy C.
Clifford, W. E.
Clifton, W. H.
Cooper, S. D.
Crawford, Carl G.
Davidson, G. M.
Dresser, Geo. L.
Drinker, Lloyd P.
Dunham, F. V.
Dunstan, J. H.
Ericson, L. T.
Fisher, Wm. A.
Foley, John
Frey, Geo. W.
Fulks, E. B.
Gibson, A.
Gosline, C. E.
Graham, F. N.
Griffin, R. A.
Grow, J. H.
Hicks, P. R.
Hill, L. L.
Howson, E. T.
Hoyt, H. B.
Jackson, W. E.
Jennison, H. G.
Johnson, J. A.
Joyce, A. R.
Kammerer, A. L.
Kuehn, A. L.
Kynoch, W.
Larkin, A. E.
Lewis, W. H.
Look, R. V.
Martin, F. R.
Mattos, F. D.
McCandless, S. P.
Meyer, A.
Mills, W. C.
Newton, H. M.
Noyes, A. H.
Paul, H. A.
Pershall, E. E.
Pooler, F. S.
Rabourn, M. M.
Rex, Geo. E.
Ross, P. A.
Sackett, H. S.
Schnatterbeck, Chas. C.
Shanesey, M. T.
Sjodahl, H. A.
Smith, Lowry
Smith, W. J.
Sporley, C. M.
Stahl, K. F.
Steinmayer, O. C.
Stocking, E. J.
Stull, T. G.
Swan, O. T.
Taylor, C. Marshall
Teesdale, Clyde H.
Tilley, C. M.
Tracy, John H.
Trumbull, M. K.
Valentine, H. S.
Van Metre, R.
von Schrenk, Hermann
Waddell, K. M.
Waterman, J. H.
Weatherly, J. L.
Wegener, R.

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Attendance at Fourteenth Annual Meeting.—(Concluded.)

Non-Members.

ALEXANDER, MRS. E. E.....Green Spring, W. Va.
ANGIER, MRS. F. J.....Baltimore, Md.
AVERY, F. H.....Engineer Bridge Repairs of City of Chicago, Ill.
BERRY, F. A.....Assistant Engineer, Bridge Department, Chicago, Ill.
CARVER, G. G.....Supt., The Jennison-Wright Co., Toledo, O.
CLIFTON, B. H.....Lumber Inspector, Wabash Ry., St. Louis, Mo.
CONE, ALBERT.....Associate Editor, "American Lumberman," Chicago, Ill.
CONWAY, S. C.....Sales Engineer, The Jennison-Wright Co., Pittsburgh, Pa.
COTTINGHAM, W. P.....City Engineer, Gary, Ind.
De BERARD, W. W.....Western Editor, "Engineering News-Record," Chicago, Ill.
DUFF, A. M.....Pittsburgh Testing Laboratory, Chicago, Ill.
ENRIGHT, F. M.....Western Sales Representative, The Jennison-Wright Co., Chicago, Ill.
FARRINGTON, JAMES.....Timber Inspector of City of Chicago, Ill.
FRENCH, M. J.....Salesman, The Jennison-Wright Co., Syracuse, N. Y.
GOODMAN, FRANK B.....Sales Representative (Canadian), The Jennison-Wright Co., Toledo, O.
GADDUM, A. W.....Sales Representative, The Brecht Co., St. Louis, Mo.
HAMMOND, H. G.....Sales Department, The Jennison-Wright Co., Toledo, O.
HONE, R. R.....Sales Engineer, The Jennison-Wright Co., Toledo, O.
JORDAN, J. H.....Salesman, Grasselli Chemical Co., Cleveland, O.
KENNY, J. A.....Sales Agent, The Kettle River Co., Chicago, Ill.
KLUNK, J. B.....Sales Engineer, The Jennison-Wright Co., Toledo, O.
LERSCH, H. E.....Salesman, John Baker, Jr., Chicago, Ill.
LICHTY, C. A.....General Inspector, C. M. & St. P. Ry., Chicago, Ill.
LINDSLEY, E. A.....Vice-Prest., Western Wood Preserving Co., Spokane, Wash.
McCARTNEY, ALVIN.....Inspector, Southern Ry., Washington, D. C.
McGRATH, R. C.....Testing Division, Bureau of Engineering, Chicago, Ill.
MATTOS, MRS. F. D.....West Oakland, Cal.
MEYER, JOHN H.....Salesman, The Jennison-Wright Co., Toledo, O.
MILBURN, J. D.....Salesman, Page & Hill Co., Chicago, Ill.
MOORE, H. H.....Lumber Agent, Pennsylvania Lines West, Ft. Wayne, Ind.
MUNDY, A. F.....Manager, The Foxboro Co., Chicago, Ill.
NIENHOUSE, J.....Assistant Branch Manager, The Schaeffer & Budenberg Mfg. Co., Chicago, Ill.
RABOURN, MRS. MARION.....Mt. Vernon, Ill.
RAMSEY, C. L.....Sales Engineer, The Jennison-Wright Co., Toledo, O.
RANE, F. W.....State Forester, Boston, Mass.
RANGES, CHARLES F.....Salesman, Eppinger & Russell Co., New York.
ROWE, C. S.....Assistant Engineer of City of Chicago, Ill.
SCHOLES, R. T.....Assistant to Chief Engineer, C. B. & Q. R. R., Chicago, Ill.
SCHWAB, C. H.....Assistant Treasurer, The Jennison-Wright Co., Toledo, O.
SHARP, A. W.....Sales Engineer, The Jennison-Wright Co., Toledo, O.
SMITH, ALFRED T., Jr.....Chief Clerk, The Midland Creosoting Co., Granite City, Ill.
SMITH, MRS. W. J.....Dennison, Texas.
SULLIVAN, R. B.....Assistant Engineer of City of Chicago, Ill.
TATUM, J. E.....Salesman, The Midland Creosoting Co., Minneapolis, Minn.
THOMPSON, A. R.....Chief Tie & Timber Inspector, Grand Trunk Ry., Belleville, Ontario, Canada.
TRATMAN, E. E. R.....Editor, "Engineering News-Record," Chicago, Ill.
VILLIE, F. H.....South Bethlehem, Pa.
von MALOTKE, MISS MARTHA.....Chicago, Ill.
WILLIAMS, L. D.....Sales Manager, Mineral Point Zinc Co., Chicago, Ill.
WINEGAR, B. M.....Forester, Canadian Pacific R. R., Montreal, Canada.
YORK, W. S.....Chief Tie Inspector, Wabash R. R., St. Louis, Mo.

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PROGRAM.

TUESDAY MORNING.

Opening by Prayer.....J. H. Waterman
Report of Secretary-Treasurer.....F. J. Angier
Report of Entertainment Committee.....A. L. Kuehn, Chairman
Communications.
President's Address.....John Foley

TUESDAY AFTERNOON.

Labor Conditions.....E. T. Howson
Conditions in the Tie Market and Present Sources of Supply.....M. T. Shanesey, P. R. Walsh, W. H. Clifton, E. H. Bowser, F. S. Pooler, H. H. Moore, A. R. Joyce, M. J. French, J. H. Waterman, A. L. Kuehn, F. J. Angier, John Foley.
Report of Committee on the Purchase and Preservation of Treatable Timber, A. R. Joyce, Chairman
Report of Committee on Promotion and Education.....E. A. Sterling, Chairman

WEDNESDAY MORNING.

Fire Protection as Applied to Wood-Preserving Plants.....J. G. Hubbell
Creosote Supply.....R. Esau, E. B. Fulks, G. A. Lembcke
Report of Committee on Wood-Block Flooring and Paving, C. H. Teesdale, Chairman
Meeting in 1919.

WEDNESDAY AFTERNOON.

Report of Committee on Service Tests.....P. R. Hicks, Chairman
Causes and Prevention of Failures of Creosoted Wood-Block Factory Floors, L. T. Ericson
Condition of Creosoted Wood-Block Pavements in Mobile, Ala., Shreveport, La., and a Number of Texas Cities.....C. H. Teesdale
Relation Between Average Life of Ties and Percentage of Renewals, Mabel E. Thorne
The Effect of the War on the Supply of Timber of Various Sizes, Dr. Hermann von Schrenk
Volume-Temperature Correction for Creosote Oil Measurements, S. R. Church and J. M. Weiss
New Expansion Factors for Measuring Mixtures of Creosote Oil and Tar, Dr. A. L. Kammerer
Report of Committee on Preservatives.....E. B. Fulks, Chairman

THURSDAY MORNING.

Report of Committee on Terminology.....Grant B. Shipley, Chairman
Report of Committee on Publications.....John Foley, Chairman
Report of Committee on Resolutions.....R. V. Look, Chairman
Report of Committee on Non-Pressure Treatments.....R. A. Griffin, Chairman
Election of Officers.

SESSIONS.

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OPENING SESSION.

The Fourteenth Annual Meeting of the American Wood-Preservers' Association, held in Chicago, Illinois, January 22, 23, 24, 1918, was called to order Tuesday morning, January 22, at 10:30 A. M., by the President, Mr. John Foley.

THE PRESIDENT: We will be led in prayer by Mr. J. H. Waterman.

MR. J. H. WATERMAN: Our Father, we thank Thee that we are privileged to get together today as an association. Wilt Thou strengthen each man in it. Wilt Thou make each of us to understand that Thou must lead us and guide us if we do those things that are right in Thy sight. We thank Thee for this body of men that conserves the resources of this country, and we pray Thee that Thou wilt teach them that they should conserve their own resources, that they may go out into the world and be manly men. Bless the organization and the days that we shall meet together. May we do those things which will strengthen us and strengthen one another. Guide us through life and with the redeemed save us, for Jesus' sake. Amen.

THE PRESIDENT: Gentlemen, next on the program are the minutes of the last meeting. If there is no objection, we will accept them without being read, since they were printed in the 1917 PROCEEDINGS.

We have a report from the Secretary-Treasurer, Mr. F. J. Angier.

REPORT OF THE SECRETARY-TREASURER.

To the Members of the American Wood-Preservers' Association:

Gentlemen: Your Secretary-Treasurer begs to submit herewith his Annual Report for the year 1917:

Cash on hand December 31, 1916		$414.97
RECEIPTS		
Admission fees	$ 410.00	
Membership dues	2,625.13	
PROCEEDINGS—Advertising	1,045.63	
PROCEEDINGS—Sales	223.28	
WOOD-PRESERVING—Advertising	1,563.57	
WOOD-PRESERVING—Subscriptions	185.71	
HANDBOOK—Sales	520.81	
Badges returned	2.64	
Interest on bank deposits	12,16	
		6,588.93
Total cash balance and receipts		$7,003.90

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DISBURSEMENTS.

Printing 1917 PROCEEDINGS	$3,042.22	
Reporting, editing, collecting statistics, and copyright for PROCEEDINGS	433.06	
Postage, express, telegrams and storage	255.35	
Office supplies, stationery and printing	167.04	
Clerical and stenographic work	510.30	
Editing 1918 PROCEEDINGS	10.00	
Printing invitations, programs and badges	89.53	
Expenses incurred at 1917 meeting	56.35	
Expenses of Entertainment Committee at 1917 Meeting	200.00	
Refund of dues	10.00	
Membership in National Conservation Congress, American Chemical Society and Chamber of Commerce of U. S. A.	26.00	
Expenses of MANUAL	27.72	
Expenses of HANDBOOK	556.16	
Expenses of WOOD-PRESERVING	1,470.40	
		6,854.13
Cash on hand December 31, 1917		$149.77

MEMBERSHIP

Last annual report		299
Elected during 1917	36	
Resigned	15	
Dropped	27	
Deceased	2	
	44	
Total net loss		8
Membership December 31, 1917		291
Corporate	232 or	79.7%
Associate	46 or	15.8%
Probate	8 or	2.7%
Honorary	5 or	1.8%
	291 or	100%

GROWTH OF MEMBERSHIP.

Year	New Members	Withdrew	Added to Roll	Total
1904	20	..	20	20
1905	7	..	7	27
1906	9	7	2	29
1907	15	..	15	44
1908	5	4	1	45
1909	13	12	1	46
1910	29	8	21	67
1911	45	8	37	104
1912	59	6	53	157
1913	37	11	26	183
1914	92	10	82	265
1915	29	18	11	276
1916	41	18	23	299
1917	36	44	*8	291
	437	146	291	
Average for 14 years	31	10	21	

*Deducted.

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CLASSIFICATION OF MEMBERS.

		Members
36	Railroads	73
1	Navigation company	1
46	Commercial treating plants	91
21	Tie and lumber companies	25
25	Commercial and manufacturing companies	35
2	National Governments	8
4	Educational institutions	5
7	Municipalities	8
2	Periodicals	2
4	Associations	6
8	Firms not classified	12
	Consulting engineers, chemists, etc	25

Honorable mention should be made of the members who during the past year have enlisted in the service of their country and whose does are suspended by vote of the Executive Committee until the close of the war. Their names are mentioned in the report of the Committee on Resolutions on another page.

GEOGRAPHICAL DISTRIBUTION.

State.	1914	1915	1916	1917
Alabama	4	3	3	3
Arkansas	5	4	3	4
California	5	6	6	6
Colorado	3	2	2	2
Connecticut	1	1	1	1
District of Columbia	4	4	4	5
Florida	4	3	3	3
Georgia	2	5	5	3
Illinois	35	41	41	44
Indiana	6	8	10	9
Iowa	2	1	1	1
Kansas	4	4	4	5
Kentucky	7	8	8	7
Louisiana	10	12	13	12
Maryland	5	5	7	8
Massachusetts	2	3	3	5
Michigan	2	3	5	7
Minnesota	9	10	12	11
Mississippi	3	3	3	3
Missouri	12	12	15	12
New Jersey	7	6	7	7
New Mexico	3	3	3	2
New York	21	24	28	29
North Carolina	..	1	..	..
Ohio	11	12	12	12
Oregon	7	5	5	6
Pennsylvania	14	12	12	16
Tennessee	3	2	2	2
Texas	17	13	14	13
Virginia	3	3	4	5
Washington	16	17	18	14
West Virginia	..	..	..	2
Wisconsin	8	9	12	10
Wyoming	3	3	2	2
	240	251	272	271
Country.				
Austria	1	1	1	..
Canada	14	13	14	13
England	4	4	5	5
Germany	6	6	6	..
India	1	1	1	1
Russia	..	..	..	1
	265	276	299	291

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Our members are scattered over 34 States of the Union and four foreign countries. Illinois leads with 44 members, New York follows with 29, the other States having 1 to 14 members each.

Respectfully submitted,

(Signed) F. J. ANGIER,
Secretary-Treasurer.

THE PRESIDENT: If there is no objection, we will refer the report of the Secretary-Treasurer to an audit committee composed of Mr. Pooler and Mr. Davidson, for report later.

Mr. Kuehn, will you be kind enough to report from the Entertainment Committee?

(The entertainment provided for those in attendance at the convention was then announced by Mr. Kuehn.)

THE PRESIDENT: There are no announcements of import to make. Has any member any announcement to make to the Association that is in order at this time? If not, we will proceed with communications to the Secretary.

THE SECRETARY: A message from Mr. E. O. Faulkner:

> Much regret cannot attend Wood-Preservers' convention. Wish you a successful and profitable meeting.

THE PRESIDENT: We have a Committee on Resolutions to appoint. Mr. Look will be kind enough to serve as the Chairman and have associated with him Mr. Lowry Smith, Mr. Jennison, Mr. Mattos, and Mr. Larkin. There are also required Tellers of Election, and the following gentlemen will be kind enough to get the ballots from the Secretary and attend to that part of our business: Mr. Cecil, (Chairman), Mr. Dunham, Mr. Walsh, Mr. Fenn, and Mr. Grow.

Gentlemen, in addressing the Eleventh Annual Meeting of the American Wood-Preservers' Associaton, Presdent Rex said:

> The handicap of the war, which has so disorganized the principal source of supply for the wherewithal to carry on our industry, has made it necessary for more than one-half of the industry to reverse its methods.

The remarks of President Rex in 1915 were brought about by the curtailment of the importations of Euorpean creosote. During 1917 those importations practically ceased. That the industry not only reversed some of its methods, but in general adjusted itself to conditions, proves that the wood-preserving industry is a stable one.

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During 1917 shortages of things other than creosote have caused the industry to make adjustments in its affairs. You have been short of fuel, of labor, of lumber, and are going to look back upon 1917 as a strenuous year, in common with business men generally. It has been hard to adjust your affairs so as to make the work you have done satisfactory to all concerned.

How far the wood-preserving industry must adjust itself, how it shall proceed to make the changes necessitated through the entry of the United States into the war, and what it should do after the war is over, are questions that are to be answered largely by what we do here in the three days ahead of us. A free and frank discussion of general conditions should be entered into. We have been very fortunate in obtaining promises from some of our members to discuss the details of various questions with us, and I am sure that the stimulation to our general attitude toward the problems will result in really constructive work. Wood may not win the war, but all of us know that wood has already contributed a very great deal, and is going to contribute more to the prosecution of the war. Possibly if we had a wood administrator the slogan that "Wood will win the war" would be a close second to "Food will win the war." When it would be said "Don't waste wood," wood-preservers would say, "That is what we have been advocating for many years."

Wood is now very much in demand. It is needed in the trenches, in airplanes, in ships, in rifles, in railroad extensions, and this abnormal war drain on the forest has not yet been counterbalanced by any cessation of usual wood consumption. The European nations at war have been making tremendous demands upon the world's forest resources. They have ruthlessly destroyed much of the timber they have not used in the countries that have been invaded, have extensively exploited the material in their own countries, and have bought much from neutral nations of Europe, where the stimulus of high prices resulting from intense demand has caused Norway and Sweden and Switzerland to make great inroads into their forests. From the United States also a great deal of lumber has gone over for various purposes. The net result is that after the war there will remain in the world only the extensive resources of the United States, Canada, and Russia. Switzerland has already placed restrictions on the cutting of its timber. Germany and France, when the war is over will, of course, do the same. Norway and Sweden also are not likely to then continue to permit the extensive exploitation of their forests. Consequently there will be a tremendous demand for material from the United States, with conse-

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quent high prices. As the price of wood advances, the necessity for conservation in its use becomes more and more apparent, and its preservative treatment consequently more likely to be considered.

The World War will affect Americans profoundly. Wood-preservers will be aware of its influence not only as individuals, but in the bearing on their industry of the changed viewpoint of those who have gone to France to manufacture and to use wood in war work. The logging and the railway regiments which are important parts of the American Expeditionary Forces will not only contribute much to the successful termination of the war, but they will come back with knowledge of intensive ways of handling forests as forests and of utilizing wood as a material which should not be wasted. Those who return to railroad service will have seen over there treated wood which had lasted more years than many of them believed possible. Among those cutting the French forests are lumbermen who will come back with ideas as to growing trees that they never had before. The result in the United States will be a stimulation to proper forest management and to conservative use of forest produce.

Wood-preservation is a big factor in forest conservation. If those of us with commercial plants look upon an order for treated material as simply a business transaction to be completed as something to bring a financial return and nothing else, do we not lose that which membership in this Association should give us—the vision that our daily work is for the good of posterity, the satisfaction that we are conserving a natural resource which is extremely valuable, and the knowledge that the result of our efforts so far justify wider use of them in the future? If the members of our Association would have the idea that without vision there is no chance for success and that we must have enough imagination to look forward to figure on what is going to happen, and to plan accordingly, they would realize that the better utilization of wood and necessarily the conservation of it as a resource which must be kept in the country if we are to prosper as a nation, is possible only through organized effort. Collective action is required to get done the necessary things which wood-preservers desire done and know best how to do. The only available mechanism for cooperative effort by the wood-preserving industry lies in the American Wood-Preservers' Association. To function best it needs your personal services as much as it needs your funds.

At present there is special need for the Association spirit. Each of us must eagerly work with the other for the good of all. This is particularly true in handling the problems resulting from Governmental

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activities. During the past year your officers have had contact with the Government in connection with various phases of United States business relating to wood-preservation, and the chances are that next year such demands on the Association will be made much more often. Consequently the Association officers should feel that they have back of them every member of the Association willing to sacrifice some of his personal and business interests for the sake of the industry as a whole. With already 22 members willing to give their lives for the cause of making the world safe for democracy, it would seem as though we, back here, should stick closely together and do everything we can to see that they are successful and that whatever sacrifices they make will not be in vain.

The probabilities are that your individual interests in this Association are based on your belief or hope that it can make your business better. It can and it will, provided you understand that it has a common purpose, which can be accomplished successfully only if you submerge yourself to the extent of becoming a worker. There is need for the help of everyone of you. To the constructive work in the technology of the industry which has been achieved in recent years must be added knowledge of the economies of the wood-preserving industry. We must have available knowledge of the resources of wood and preservatives upon which our operations depend; we must know what our work costs; and we must have for the guidance of the operator and the education of the public the facts, based on uniformly-obtained data, which justify the position we desire to assume as experts capable of doing good (applause).

In the printed program, gentlemen, it was not possible to include at the time it was issued everything that the Committee had arranged for, and Mr. Trumbull, its Chairman, will be kind enough to let you have by word of mouth the revised program. Those of you who cannot keep track of it in its reading will find a copy posted at the registration desk, so that you can time your arrangements accordingly. I hope very much that everybody will realize that the success of our meetings lies in full attendance and in prompt arrival.

(Mr. Trumbull then announced the program of the convention.)

THE PRESIDENT: There seems to be nothing pressing that we should take up this morning. We will proceed with our program in regular order this afternoon. By letting you off early this morning, we hope to induce you to come early this afternoon. In the meantime devote yourselves to getting acquainted. I see about some

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new faces, and I hope the old members will do what they know how to make the newcomers feel welcome.

Mr. Church has just acquainted us with the fact that Mr. Esau, the Manager of The Barrett Co., in Chicago, is prepared to comply with our request to discuss the creosote situation, and we will hear from Mr. Esau tomorrow morning, about 11 o'clock.

The suggestion has been made that the decision regarding the selection of the 1919 meeting place be transferred from Thursday afternoon to Wednesday just before noon. We never have had as large a vote on that subject as we should, and since the largest attendance generally is here Wednesday morning, please bear in mind that the program has been altered to that extent. Everybody who has an idea that his town should be the place chosen will please be on hand to see what he can do to move the meeting. If there is no business to be brought up by the members——

MR. E. B. FULKS: I would like to ask what the status of the various recommendations for adoption is now?

THE PRESIDENT: I understand that there have been received 73.2% of the ballots sent to the members and that the votes for the recommendations as to standard practice are practically unanimous in favor of all of them; so everything approved in New York last January has been adopted.

MR. E. B. FULKS: Might I make a few remarks about this affair?

THE PRESIDENT: Certainly.

MR. E. B. FULKS: It seems to me there is a little inconsistency in the Constitution about this matter of adopting standards and so on. I have not the Constitution, I cannot quote it exactly, but Article X, which relates to the adoption of standards provides that they shall be submitted to letter ballot in case two-thirds of those attending the meeting vote in favor. Notice the wording, "of those attending the meeting."

THE PRESIDENT: Would you mind if I read what is in the Constitution?

MR. E. B. FULKS: No, I wish you would.

(The President then read the Article of the Constitution referred to.)

MR. E. B. FULKS: That is just my understanding of it, that anything proposed for adoption in the regular way shall be submitted

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to letter ballot, provided two-thirds of the members at the Annual Meeting vote accordingly, is not that the idea?

THE PRESIDENT: Yes.

MR. E. B. FULKS: What is the meaning of "at the Annual Meeting?" Last year there were 89 in attendance at the Meeting allowed to vote. Construing "at the Meeting" to mean those registered as at the Meeting, it would require a vote of 60 to have referred anything to letter ballot. Now I fancy that at no particular time were there 80 members in the hall when anything was voted on. Assume that 60 were there. Following that construction of the Constitution, all those 60 would have to vote in favor of referring to letter ballot; else it could not be referred.

The Constitution further provides that 20 members constitute a quorum. It is easily imaginable that at any time there might be 20 members at the Meeting. In that case 11 members can amend a proposed standard of a committee report. It says, in relating to amendment, "In case the majority of those present and voting, vote affirmatively." That very clearly means the majority of those sitting in the room and voting. There is no question about that. So that at any time there might be 20 people, and in that case 11 of them could have amended any committee's report. Now, it seems to me, that is not giving committees a fair deal. I have never known an instance where somebody opposing a committee's report suggests something that the committee has not already considered. Nobody ever brings up anything that is new to a committee on such occasions. The committee has not followed that line for reasons which it thought were good and sufficient after thorough study, but it is very possible to have the committee overridden simply by some good-talking fellow.

I am not going to suggest anything. I have no motion to offer, but anyone will readily see that it is easier for somebody to upset the work of the committee than it is for the committee to get its work adopted. It seems to me that if you appoint committees and expect them really to do good work, they ought to have a fair deal and that somebody who has not worked on the thing very long or very earnestly, or even if they have, should not be allowed to come up at the last minute and have the advantage of the committee to this extent.

Personally I think that committee reports offering standards for adoption ought not to be allowed to be amended from the floor. I do not mean that they should be arbitrarily forced on a convention, but

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there can be some less drastic thing done. If there is an appreciable number of the convention disagreeing with the committee it might be proper to refer the matter back to the committee or something like that, but not arbitrarily to override the committee's work.

THE PRESIDENT: I am sure the Association is glad to have Mr. Fulks' comments. A suggestion is that Mr. Fulks propose an amendment to the Constitution which fixes it as he believes it should be. Having had something to do with making this Constitution, I can say that the "present and voting" idea was expected to carry through the next sentence. I think the Chair would always interpret that as providing that there must be two-thirds of those actually voting (present and voting), just as would be the case with the amendment. It also strikes me that it should be permissible to amend something a little more easily than it is to reject it. If an individual suggests something to the committee and he can get a majority of those present with him, I believe that in the majority of instances it will be the case where the committee would not object very much to whatever the slight change may be. Then, of course, two-thirds of all those present would be required to have that particular recommendation approved before submission to letter ballot. However, if "two-thirds of the Corporate and Honorary members at an Annual Meeting" can be interpreted to mean "two-thirds of those who are registered," the Constitution should be changed. It is always subject to amendment, and I guess Mr. Fulks can get enough members to join with him in proposing an amendment at the next Annual Meeting, so that everybody will have a like understanding of the Constitution.

MR. E. B. FULKS: Mr. President, do not misunderstand me. I am not objecting or proposing anything, but I thought this was worth calling attention to and having some discussion on the subject. I do not care to offer any amendment to the Constitution, but I think it should be clarified.

THE PRESIDENT: Does my interpretation of it make the thing any less liable to go wrong, in your opinion?

MR. E. B. FULKS: Yes, certainly. Of course, I assumed that was it; but the interpretation I offered was entirely allowable, so I wanted to call your attention to it.

THE PRESIDENT: Has anybody else any ideas along this line that they would like to present to the Association?

MR. CARL G. CRAWFORD: The interpretation that I placed on the clause, namely, that two-thirds of the members at the meeting,

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means two-thirds of the members at the session in which the question was put to a vote. However, in view of the fact that in our Constitution our annual convention is referred to as our Annual Meeting rather than a convention, this clause can very easily be interpreted to mean two-thirds of the members voting at the convention, and in view of this, I think the suggestion that has been made should be acted upon and the wording in our Constitution made clear.

MR. S. R. CHURCH: I have followed what Mr. Fulks said with a great deal of interest, and in general am in sympathy with his remarks. I think a suggestion is in order that whatever the interpretation placed on this matter of the number of members present at the meeting may be, that the same proportion of members present required to support a committee's report and place it before the Association for letter ballot should be required to amend a committee's report. I cannot altogether agree with the Chair that an amendment is usually a slight alteration which would be entirely acceptable to the committee, because, as a matter of fact, an amendment to a committee's report may entirely reverse the opinion or decision of a committee on some very important feature.

THE PRESIDENT: Would anybody else like to express himself on this point? If there is no more discussion about it, I think we can with advantage leave it to the next Executive Committee to decide whether they will work out an amendment to the Constitution or invite such an amendment from those who feel that the change should be made.

If there is nothing else to be presented we will adjourn until 2 P. M.

An adjournment was then taken until 2 P. M.

TUESDAY AFTERNOON SESSION.

January 22.

The meeting was called to order by President Foley at 2 P. M.,

THE PRESIDENT: Gentlemen, in the operation of wood-preserving plants the turn-over in labor during the past two years has been extreme, and I think we are decidedly fortunate in having Mr. E. T. Howson, Associate Edtor of the "Railway Age" and Editor of the "Railway Maintenance Engineer," speak to us on this subject this afternoon (applause).

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MR. E. T. HOWSON: Mr. President and Members of the American Wood-Preservers' Association: I doubt if there is anybody who is not having difficulty in securing a sufficient supply of labor today. The trouble is universal. It is impossible to compile any figures showing the total shortage of men, but it is up in the hundreds of thousands, at least. The officers of the Southern Pacific made some tabulations just recently respecting its maintenance of way forces comparing its present forces with those of a year ago, and found that they were employing about 10,000 men, in September, 1916, while last year they could secure in that same month only 6,500. In other words, they were 4,000 men short on the one railroad. That condition has extended over all railroads, and it is not confined to the railroads but industrial plants are confronted with the same situation. I know of a number of the men here who are finding difficulty in getting labor at their wood-preserving plants.

There are a number of causes for this situation. In the first place, the United States has drawn its unskilled labor primarily from immigration from Europe. In the 10 years immediately preceding the war an average of slightly over 1,000,000 men came into this country. With the starting of the war that number dropped 75%, and now less than 250,000 are coming into this country each year from all sources, as compared with over 1,000,000 four or five years ago. In addition to that there has been a very great withdrawal of men from this country, reservists going back to fight in the armies of the various belligerent nations, so that the number going back has almost equalled the number coming into this country since the beginning of the war.

Of the classes employed as the members of this Association would employ them as laborers in their plants (ordinarily classed as they enter as "laborers" or as "agricultural employes") approximately 90,000 entered this country last year, and 101,000 left, so there was an actual loss of 11,000 men of this class.

We all know that there is no opportunity to bring labor from Europe, at least during the war. That source of supply is shut off. A great deal of attention has been given to Mexico, particularly by the roads running into the southwest, and yet the Mexican supply of labor has been overestimated, in my opinion. A few days ago I checked up the records of the number of men coming in from Mexico, and in no year have they exceeded 22,000 averaging from 15,000 to 18,000 men a year. When we compare that figure with a total of 1,000,000 men coming in from Europe we can see that it is insignificant. But even to make that matter worse the alien labor law which went into

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effect the first of last May shuts off practically all of the Mexicans. In the month of April, 1917, approximately 1,500 Mexicans came across the line, while in the month of May, 1917, the month following the inauguration of that law, 96 came across, and in no month, with one exception, since the law went into effect, have more than 200 Mexicans come into this country.

The only foreign source of labor from which we might expect any relief is the Asiatic labor. We all know that there are large numbers of men, coolies and others, that we could get in China. Trainloads of these men have been moving across Canada in the last two years on the way from China to France where several hundred thousand Chinese and East Indians are now employed in the construction of roads and various works behind the lines. Many railway men, particularly, have said we ought to let down the bars on the Chinese and bring 200,000 or 300,000 or 500,000 over, if necessary under contract to return them at the expiration of the war, but the United States Department of Labor has taken a very firm position on this suggestion, and it is significant to note that in spite of the agitation along that line not a single bill has been introduced into Congress tending to remove those restrictions. One reason for that is the strong sentiment on the western coast against bringing in labor of that kind.

The Department of Labor and the authorities at Washington are so fixed in their position that before any measures can be put into effect it will be too late, so that we cannot expect any relief from that source.

The question then arises, where are we going to get relief if we cannot get it outside of the borders of the United States? There are now more Porto Ricans than the resources of that country will support during the next year, and food will either have to be taken to them, or they will have to be taken out, so the United States Department of Labor is now planning to bring 110,000 of those men into this country to work in the southern States. They had expected to do that last fall, but some complications, brought about partially by Government restrictions and partially by the attitude of certain employers in trying to beat their competitors in securing men, blocked that. The problem now is to get boats to bring those men here, but the Department of Labor assures us that bottoms have been provided to transport 50,000 of those laborers here in the next few weeks. Those laborers will be placed primarily in industries and on roads in the south where climatic conditions will approach those to which they are accustomed.

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In attempting to fill the shortage which now exists, the United States Department of Labor has been given very broad powers. Within the last two or three weeks additional legislation resulting in the reorganization and broadening of the work of the United States Department of Labor has given it authority even to the extent of conscripting labor. They have the authority to determine priorities of labor and they are already giving consideration to that point. In a letter which I received from an Assistant Secretary in the Department of Labor three or four days ago he makes the statement that the United States Bureau of Labor is already checking up industries. They are going to select the essential from the nonessential for labor just as is now being done for materials, and those industries which are most essential to the welfare of the nation and the business it has ahead of it now are going to be favored with labor. The details of that plan have not yet been worked out, or at least they have not been made public. It is not my impression that they will say to certain men "You must work in a certain factory," but the statement has been made that they are going to say to certain industries, "You shall not bid for labor," and to certain industries, "You can come in and bid." They have found the situation existing in certain industries that manufacturers having war contracts at very favorable prices have been able to pay high rates and thus outbid other industries which did not have the same percentage of profit. They have forced the rates up, have advertised extensively, and have actually maintained a surplus of labor about their plants to fill any vacancies. There has been a wastage of labor at those plants, because of the men who have waited around for these high-priced jobs. This has not been confined to a few men, but it has affected thousands of men. The Department of Labor has already over 100 Government-operated labor agencies, and is developing a plan of cooperation with States-operated agencies, of which there are 134, giving it over 234 agencies under Government supervision for the recruiting of labor. It is planned through those agencies to eliminate as far as possible the shipping of laborers long distances.

In addition to eliminating the waste of labor the question arises as to how we can supplement the labor we have in various ways. One way that has been given a great deal of publicity has been the employment of women. In some industries women can be employed very effectively, but I doubt the advisability of putting them out in a tie yard to stack ties. Work of that kind is entirely out of their class. I do not believe that the wood-preserving industry will gain any relief from the employment of women other than by releasing an occasional man here and there in clerical positions in the offices. I think that this ought to be done as far as it can be done consistently

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in order to use those men where they can be employed most intelligently as inspectors in the yard or in various ways in work that women cannot do.

There is another field that the railways are just beginning to develop that I believe can be developed by the men in this Association equally well; that is, to use the younger boys. One railroad sent its track supervisors into the high schools along its line last spring arranging with the principals for the supervisors to have 20 minutes or half an hour to present the advantages of track work to those boys over 16 and under 18 years of age. They pointed out the advantages of outdoor work, of learning something of railroading firsthand, etc., and on one division that road secured 150 boys. They, of course, were organized into special gangs to do the lighter work on the right-of-way, trimming up the ballast, the ordinary policing and cleaning of the station grounds, etc., and in that way they relieved the men of that work so they could take up the heavier work. The extent to which boys of that character can be employed around a timber plant is limited, but I believe there is a field for their employment in small gangs.

To my mind, the most important field for the conservation of labor in the wood-preserving industry is the greater use of labor-saving equipment. A great deal of the material handled is more or less standardized in size. Ties, for instance, are relatively uniform in size, and that condition is highly advantageous to the development of labor-saving equipment. You will find on going into many tie yards that the men are handling ties by hand one at a time. You can go into other yards where they are handling them with locomotive cranes. The use of labor-saving equipment is economical and will show a saving, but I believe now, that even more important than the question of economy is the fact that such equipment will enable work to be done that you may not be able to do otherwise. The commercial treating man is in a somewhat different position from the man operating a railway plant, in that it is not so difficult for him to adjust the wage rates to war conditions. He may be able to bid up more effectively against the other fellow, but the railway man in general has his rate fixed and there is a great deal of red tape and difficulty in getting that rate increased, because it bears a relation to similar rates in other departments. However, in any case, bidding up against the other fellow is not the solution of this labor question. If anything, it tends to work away from the solution, in that it demoralizes labor. You take men away from the other fellow and he, in turn, bids up against you and gets part of your men back while creating unrest all around.

Last week when we had a heavy snowstorm in Chicago one or two of the railroads bid as high as $1.00 an hour for laborers to shovel

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snow where the prevailing rate had been 35 to 40 cents for snow work before. Large numbers of men were put on by the railroads at $1.00 an hour to shovel snow. The hobos shoveled snow a couple days and then were independent the rest of the week. It demoralized the entire market and actually decreased the amount of work performed, for there were many hobos on Clark Street and on West Madison Street who had been getting 50 or 60 cents an hour and had quit and were waiting for the $1.00 an hour or nothing. The employer who could not afford to pay $1.00 an hour found that his work was left undone.

In addition to the labor-saving equipment there is another consideration which is of importance in gangs of floating labor. I refer to the care you give to provide proper living and working conditions for the men. Little things, such as shower baths, will do a great deal to make the work attractive for the men who are handling "black" ties. That kind of thing has been overlooked when we could get plenty of men, when we knew that if a man quit we could get another one. We were in a position to be independent, but now the industries that have spent some money to take care of their men have been the ones that have profited in the emergency. Last week it so happened that I made a trip around several labor camps two days before the big storm, and I was in two railway-operated camps, one of which held 170 men and the other 100 men of the ordinary West Madison Street hobo, and I saw the condition in these camps. One road had spent $13,000 for its camp, and the other had spent about $10,000. The camps were as modern as any I have seen for labor of that character, nothing elaborate or extravagant, but they were comfortable for those men. After the storm I called up the engineers in charge of the maintenance of the terminals on each of those two roads and their stories were the same, that they held their gangs intact without any losses and with their prevailing rates, in the face of $1.00 an hour bid downtown, and the men in their camps knew that this rate was being paid. They were comfortable and they knew that their rate was going to continue indefinitely. One man said, "I paid for a quarter of my camp in that storm by being able to open my yard with labor at 40 cents an hour instead of $1.00 an hour."

I believe with more attention given to men of the laboring class a great deal can be done to hold the men in the service.

There is just one more thing that I want to refer to, and that is, that the practices which we establish now are going to continue long after the war is over. I believe, that the labor shortage is going to continue indefinitely after the war. There may be a slump, but we are going to be short of labor. In the second place, improvements which we are going to adopt now are going to justify themselves so fully that we are going to continue them. Therefore, I think that

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rather than take the position that this condition is a temporary one and that we will do the best we can until it is over, the men in this field, as in other fields, should study the labor situation and adopt measures with the idea that they will be permanent and that they will go a long ways towards solving the labor problem (applause).

THE PRESIDENT: Gentlemen, this should be a fruitful subject for discussion. Mr. Howson has made it clear that we should have sufficient foresight to realize that after the war conditions of similar kind must be met and that we should begin to prepare now. Not a few here have used labor-saving devices, and I hope nobody will hesitate in giving the rest the benefit of his experience. We had hoped to have here some of those who manufacture such devices. Mr. Taylor, would you mind enlightening us along this line? A few years ago you reported on results with cranes.

MR. C. M. TAYLOR: I have to say only that the Hilke stacker people are still working on their stacking machne. The Lackawanna people have given an order for one when they get them built. The original one which they built, and which some of you saw last winter in the Lackawanna yards, is still there. They have not used it very much. They had not used it hardly any.

Maybe some of the other members can add something to the labor situation. I am rather interested to know why Mr. Howson did not suggest anything about Portuguese, Spaniards and the Finns, of which my whole force now consists. They are sailors that come over to the Brooklyn yards every day or so, for the Portuguese and the Spaniards are about the only people who are now on boats. A lot of those fellows are coming into New York at the present time. They do not spend many weeks with you, but while they are with us we get all out of them we can. As one who has worked in the South and lived in the North, I hope that the railroads will all discourage the importation of the negroes to the North. Anybody who has lived in the South knows that is wrong, and I hope any of the fellows who have a chance to discourage that movement, which already has had very serious results, will do so (applause).

MR. J. H. WATERMAN: Mr. President, If you would take away the colored fellows that I have handling ties I would not have anybody left. The best device I ever saw to handle ties, and I think my friend Crawford will agree with me, is a negro (applause). We are not going to let the fellows down South have all them. We are going to have some North if we can get them.

I believe a crane is a very economical labor-saving device. Our friend told us about a crane that you could buy for $7,000 two years ago is worth $15,000 to $20,000 now, in fact we got one, a 30-ton crane,

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and I think we paid for it between $7,000 and $8,000. The Purchasing Agent's office said to me, "We can get $16,000 for it now if you do not need it." I said, "What will a new one cost?" He said, "Twenty thousand dollars."

Now you are up against high-priced labor, and you are up against high-priced labor-saving devices.

Our friend, Rex, has got four locomotive cranes. I think he is better off than any man I know of at a tie-treating plant. A crane is the best and most economical labor-saving device that I ever saw around a tie plant. We have done things with our crane that I had never believed we could do. For instance, we load 600 cars of switch-ties in station order, and we load them in stock cars, and we load them with a crane. I said you cannot do it unless you tear your stock cars all to pieces. You will have the roof off and you will kill some men. However, If I remember right, we pay 16 to 20 cents a 1,000 bd. ft. for loading them in stock cars, and the men make $4.00 and $5.00 a day. We have an engineer on the crane and three men, two men in the car and one outside to make the tongs fast, and we do not use twin tongs either. They have become so expert that there is not one time in a dozen, one time in a hundred, but that they center the tongs and put them in the side door. These three men and the crane engineer will load from 8 to 9 cars a day. The question is labor, money. Those of you who have not cranes, get your $20,000 and go out on the market and get a crane, if you do not know how to use it, come down and we will show you (applause).

THE PRESIDENT: Mr. Fisher, would you mind telling us about the electrical crane you have at one of the plants?

MR. WILLIAM A. FISHER: The Michigan Wood-Preserving Co., which is probably the one Mr. Foley refers to, has a monorail crane which loads cross-ties into open-top cars, handling a tramload of ties at a time, and they handle those trams at the rate of one every 2½ minutes, if I am not mistaken. That is about the average time of handling. The device consists of an overhead motor which raises and lowers a tong device, which opens, drops down and closes over the ties on the tram, is raised and travels to position over the open-top car and drops the ties into place. The device works with two or three men, including the man handling the hoist.

THE PRESIDENT: Mr. Rex, we have heard about your four cranes. Perhaps you could help us from your experience.

MR. GEORGE E. REX: I have nothing important to add to what has been said. The locomotive crane is the one labor-saving device that has been developed. When you pay your bills at the end

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of the month you will find your bills cut in two when you have sufficient cranes to do the work. We happen to have five of them, and if I had five more I could use them to very good advantage. There is only one operation in the tie yard that I have not been able to figure a crane can do successfully, and that is the unloading of ties out of cars for seasoning and piling in the yard. It is the one problem that is worrying my brain right now.

I am afraid when spring comes and the negro finds 30-cent cotton very inviting we will not have sufficient labor. We have been operating the last two years under very adverse conditions so far as labor is concerned. If I had not had the cranes we simply would not have been operating, and as I said before, we have cut our labor 50% in the handling of treated ties off the tram. That is, we have halved the original price, which probably is not over one-third of what the present price would be. Today if we had to handle our ties by men we would not be operating.

I think that we, as an Association, could help materially in the situation by developing a machine like the loader that Mr. Taylor speaks about. He and I thoroughly believe that machine capable of solving the difficulty of piling ties for seasoning. Unfortunately, finances have kept back the company that has the device under construction, and it has not been able to do a great deal with evolving it. Unfortunately, the patents prevent anybody else developing the idea along the same line. If this Association could in some way get together and encourage the output of that machine it would be a big step in advance.

MR. F. J. ANGIER: We are new in the use of the locomotive crane. Our people purchased one for our Green Spring plant about six months ago, after I had worried them for two or three years. They were doubtless skeptical as to its real economy at a tie-treating plant, because I was expected to show a saving equal to its cost in one year. This I agreed to do, and after one month's use I think our report showed that we had made an actual saving of over $700.00. This was the difference between our regular day-labor rate without the crane and the piece-work rate with the crane. We have not been able so far to handle untreated ties from cars to ground. Our principal work has been to load treated ties from ground to coal cars, and from trams to ground, also switch ties and piling. I am sure our people will never regret the purchase of this labor-saving device.

THE PRESIDENT: Mr. Kuehn, would you mind telling us some of your experiences in the handling of labor-saving devices?

MR. A. L. KUEHN: This problem is vitally interesting to all

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of us. I know we all have the feeling that this part of the operation should be done with a smaller number of men.

A good deal has been said about the handling of black ties, or treated material. As a matter of fact, in the big tie yards, this part of the work is comparatively easy to handle if you have a well-trained gang. We can cut down somewhat by cranes the cost, but make no great saving in the number of men. Unfortunately, the untreated ties—I speak of ties particularly—come to us in closed-top cars. They are hauled long distances, and this is the only way they can be handled, as open-top equipment is more necessary for coal.

We have been studying the unloading of ties in the backyard a long time, and have had a number of schemes for taking ties out of a box car and putting them in piles. The part of that operation which requires the hardest work on the part of the tie-handler is getting the tie from the corner of the car to the door. This takes a good, husky tie-loader, as you all know. After the tie has been brought to the car door, it can be handled by a machine to the pile, and here the lifting of the tie to the top of the pile requires the greatest amount of work. The horizontal movement requires only a small part of the work. However, even with such a machine, it is hardly possible to reduce the number of men.

I have beeen watching the stacker which Mr. Taylor spoke about. This machine does the lifting, which takes from the tie-handler a considerable amount of work. The work required by him for the horizontal movement, however, is small. This machine, therefore, only assists in the work required after the tie has been brought to the car door; and its relief to the tie-handler is principally the raising of the tie to the top of the pile. Unfortunately, the power necessary to handle the proper number of ties per minute requires a heavy machine, and unless you have a number of these machines, the work which has been saved the tie-loader will be used in moving such a machine around. We have worked on a device, based on the requirement that the apparatus shall be so light that a couple of men can easily carry it around. This is impossible with a stacker such as that referred to by Mr. Taylor. Instead of having beams and trusses, cableways must be used. So far, we have not been able to do much in the way of actual cost-saving or decreasing the number of men. However, we have hopes of making the work lighter so that a lower grade of labor can be used.

I always feel, when watching men working in the backyard unloading ties, that we must do something to cut down the number of men. But we always meet the problem of the heavy work required in handling the tie to the car door in unloading. The only answer to

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this problem of unloading ties in the backyard is to load the ties in special cars in such a way that they can be handled by a crane in lots directly from the car to the pile. This should be done where the tie-production territory is so located with respect to the treating plant that special equipment can be built and kept in the service. However, when ties are shipped from Missouri, or even the high-river territory, to Toledo or east of that even, it seems almost impossible to have special equipment for this work.

To sum up, we can possibly design a machine which will do the lifting to the pile, and that is about all we can expect.

THE PRESIDENT: As the discussion proceeds, we find that wood-preservers have not been as lax in thinking about intensive management as might have seemed at first; yet we must not figure that the matter is settled. There are improvements that can and will be made. Would Mr. Larkin mind speaking on this subject from the point of a commercial plant with varied kinds of labor and materials?

MR. A. E. LARKIN: Mr. Chairman, I cannot shed any light on this particular discussion, because my work personally is confined very largely to the handling of paving blocks where the unit to be handled is very much smaller than the larger timber, and therefore presents less difficulty from the handling standpoint and the adoption of labor-saving devices.

THE PRESIDENT: Mr. Howson gave us various angles of this question, not all of them being confined to labor-saving devices. Does anybody have any experiences in connection with the labor situation itself with which to enlighten us? The Pennsylvania Railroad Co. has two plants, one in Philadelphia and one in Mount Union. At Mount Union we are in competition with a powder works and a refractory and, of course, we are not able to meet their wage scale. As Mr. Howson said, it is also necessary in considering the wood-preserving plant rates to reckon with those of the track forces. If the men handling ties at piece rates get much more than the track men are getting at hourly rates, the latter would come for work at the wood-preserving plant.

At Philadelphia we are in competition with the various textile and other industries and are not able to keep the force needed. Undoubtedly these conditions are duplicated wherever a wood-preserving plant is in operation, and if anybody has hit on a means for holding men, we would be glad to learn of it.

Mr. Valentine, how do you manage in Jacksonville to meet the competition for labor you must have there?

MR. H. S. VALENTINE: We use nothing but negro labor.

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We have three locomotive cranes and we would not do without them in handling our heavy lumber and piling.

MR. M. K. TRUMBULL: Mr. President, I heard a statement by one of the members yesterday which brings up another phase of this question of labor supply, and that is the question of "organization" among a few men that are now available. It would be well if there is any evidence of such development in other parts of the country, besides the locality of which he spoke. That gentleman might throw light on the subject which he mentioned yesterday.

THE PRESIDENT: We would be glad to hear from the unnamed gentleman if he is in the room.

MR. A. R. JOYCE: You are indebted to Mr. Trumbull for calling on me. At Joppa, Ill., and points on the Ohio River, which are quite isolated, there are, generally speaking, no industries except the handling of ties and the treating of ties.

This year a representative of the American Federation of Labor came down to two of those points and persuaded tie-handlers, both black and white, that they were dissatisfied, got them to form a union, and they struck, and at both of those points the various companies operating have been forced to recognize the union and to raise the scale of wages.

The increase in the wage itself is all right, but the way it came about is not very pleasant. There seems to be a spirit of carelessness that is growing among the men. The number of accidents we have been having are increasing, and there is not the old spirit on the job that there used to be. It is rather peculiar, because those two towns always had plenty of labor, always had cheap labor, always had good labor. We could do down there things that could not be done in other parts of the country, and now the organizers from the outside have come in and they have been recognized and we notice a decided difference.

THE PRESIDENT: That is an interesting and suggestive development. Many laborers at wood-preserving plants have become wedded to their work, and go from one plant to another. Every once in a while we get men who tell us of a dozen plants they have worked at before. They stay several months at a place and then go on to another. If organization has started at one place it is not going to be very long before a few men from there will come to another plant and start the same thing. While I assume that the American Wood-Preservers' Association is not opposed to the principle of organization, some consideration should be given to the matter in order to see that it proceeds along lines that will not jeopardize the industry.

Mr. Howson spoke also of the matter of taking care of men. I

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wonder how many plants there are that have given consideration to the nationalization of their employes? Mr. Taylor says those of us who operate in the east have experience with Finns, Portugese, and Spaniards. None of them has yet drifted from Port Reading to Philadelphia, but I suppose they will come. Most of our men are Austrians. To teach English to them, to acquaint them with the Constitution of the United States, and to encourage them to as rapidly as possible become American citizens, is looking after other than their physical welfare, and it amounts to a very great deal in encouraging the men's loyalty. Undoubtedly taking care of the men in the way of shower baths and good living conditions goes very much toward equalizing the wage scale. Can anybody enligthen us along such lines? Are there any experiences which have not been talked of lately among wood-preservers?

MR. M. K. TRUMBULL: Mr. President, possibly all of the members do not know of the National Americanization Committee which has its headquarters in New York City. I am quite sure this committee would be glad to furnish any literature which might be wanted, indicating methods that are pursued, in manufacturing plants of all descriptions throughout the country and municipalities, for doing just that character of work. Such is the function of this committee. Any member of the Association can readily secure all the information desired and assistance no doubt in the way of visits on the part of traveling representatives.

The organization is comprehensive. A wonderful amount of work has been done to put immigrants in touch with the spirit of American life. Immigrants are not only instructed how to speak, read and write English, but are taught the fundamentals of our Government.

Immigrants reach here with the idea that they are coming to freedom and they are too often rebuffed quickly after arrival on account of falling into the hands of profiteers.

One function of this National Americanization Committee is to avoid this; to prevent these designers meeting them upon arrival at the railway stations and at the docks and to direct them on their way. Most immigrants have some objective. Very frequently they never reach their destination, because of the manner in which they are approached when they first arrive. It probably might be a very good scheme for our Executive Committee, or our Secretary to get in touch with this National Americanization Committee to the end that the material will be available for all who inquire for it. There may be some inertia to be overcome on the part of individuals in sending for this material. If any would like the information just communicate with our Secretary. I am quite sure they will be supplied.

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THE PRESIDENT: To make the thing as simple as possible, if members who have any foreign labor whatsoever will communicate with Mr. Angier, he will be very glad to arrange that you are supplied with the literature that this National Americanization Committee gets out. As Mr. Trumbull says, it is an organized body which has traveling representatives who will arrange to give lectures and other help to anybody who is interested in getting a group of foreigners to become American citizens.

MR. S. R. CHURCH: Mr. Chairman, we employ several thousand laborers at our plant, and as they are located in various sections of the country we have naturally, I think, an opportunity to study the labor situation from various angles, and there is one point that I would like to bring up for your consideration.

We have found from cost analyses that labor turn-over is a very expensive thing. Therefore, the question, having secured your labor is, how to keep it. Now from two motives, one in order to give the men a just compensation to meet the increased cost of living and from the more selfish motive of offering them inducement to remain and thereby saving the labor turn-over cost, we have instituted a bonus system which we have not stated to be a permanent institution but which has now gone on for several years. It is based on a percentage of the man's wage and depends on the length of time which he has been in the employ of the company. We have paid that bonus at the end of the year. The result has not been altogether satisfactory. One of the worst features can be exemplified by the experience of one plant where, having paid the bonus at the end of the year, out of 250 men employed at that plant only 65 showed up for work during the week after they had received this extra money. It is, therefore, a matter of some consideration now, and we have not arrived at the solution in our own minds, as to whether the bonus should be paid in one lump at the end of the year, or whether it should be paid in quarterly installments or monthly installments. If any one has had any experience along those lines we would be glad to get it.

MR. J. H. WATERMAN: Mr. Rex, how does your road pay the bonus?

MR. GEORGE E. REX: As you are all perhaps aware the Santa Fe has been paying a bonus to its men, payment being made every six months, and includes employes of subsidiary companies, of which the Santa Fe Tie and Lumber Preserving Co. is one.

There is no question but that the prospect of this bonus has helped us to hold men for six months, but when it is paid we did not have a negro on the job for four days.

We have now decided to pay the bonus with the usual weekly

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pay envelope; whether this will work out any more satisfactorily remains to be seen.

MR. J. H. WATERMAN: Mr. President, did I understand that there might be objection to tie-plant men getting more money than track men?

THE PRESIDENT: Yes.

MR. J. H. WATERMAN: Let us take 400 ties as a unit in a car, and you pay 1 cent a tie (many of you pay more than that and some less), that is $4.00 to unload the car. I would like to have somebody stand up here who has worked hoboes and tell me if you can get four hoboes to unload more than 400 ties a day. I cannot do it.

I went out one morning to the tie plant and a negro by 9:30 had unloaded 400 ties, and he got in another car and had that out by 1 o'clock. That cost us, say, $8.00. Hoboes would cost $20.00. It is not what you save; it is what you lose. It is not what you pay the tieman by the piece; it is what you lose when you hire the other fellow. I tell you, (and I defy anybody here to contradict it), that one tieman, whether he is an Austrian or a negro, a Hungarian or whatever he is, will do more than four hoboes day in and day out, week in and week out, and why ought you not pay the man if he will do it? There are some preachers getting $12,000 a year. What for? Their brains. Now, if I have the muscle to do what four men can do, ought I not be paid somewhere near what the other fellows get? I say we ought to pay for muscle just as well as for brain.

One thing more. He spoke about houses and looking after the laborers. I think every railroad in the country has been up against that. I know our road has woke up to that. Our road sends a special man over to inspect the car bodies, and fix them up for the men and give them what they want. We have quite a number of car bodies, and when one man moves out and the other fellow moves in, we say, "What do you want?" If he wants a window closed where the other fellow had one, or wants another window somewhere else we give it to him. If he wants a new floor we give it to him. We have one negro camp and one hobo camp and I like the negro camp the better, because they do the best work.

THE PRESIDENT: Will you close the discussion, Mr. Howson?

MR. E. T. HOWSON: Reference was just made to the labor turn-over. Some figures came into my possession in the last three days along that line. One of the western railroads that Mr. Waterman is familiar with kept a check on the number of men sent to one division in the working season of six months and found that it had

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shipped 14 men to keep one on the job. There is a labor turn-over twice a month in an agricultural community.

Another railroad in the Pittsburgh district during the season of 1917 shipped 10 men out to keep one man in the gang. I do not know of any timber-treating plant where the turn-over is that high, but I do know where it approaches it.

We do not need to emphasize the cost of getting those men recruited and out on the job, trained and broken in and getting them so they are efficient. Unfortunately with a lobor turn-over like that, by the time you get them efficient they are gone. It is a tremendous expense, and I think it is worthy of the best efforts of the men of this Association to study that labor turn-over, see what the reason for it is, and endeavor to get away from it.

The question of bonus has been referred to, and it occurred to me that a solution that one road in Chicago has worked out in a limited way might be of value; that is, an increasing rate for increased length of service. A man starts in at the prevailing labor rate. If he stays a certain length of time, 30 days perhaps, they raise him 1 cent an hour, and at certain intervals they again raise him so that the longer he sticks the higher is the rate which he receives. If he leaves his camp his name is dropped from the roll, and when he comes back he starts at the bottom again. In that way it has been found possible to hold some of the transient labor.

THE PRESIDENT: Would anybody else like to contribute to this discussion? We have with profit heard Mr. Howson and the other gentlemen on this topic, which absorbs a great deal of the attention of operators of wood-preserving plants. Since there is no more discussion, we will proceed to the next subject. It was expected that we would have a synposium on the subject of "Conditions in the Tie Market and Present Sources of Supply." Mr. Shanesey of the New York Central Lines will start it.

MR. M. T. SHANESEY: Gentlemen, I sincerely appreciate the honor which has been conferred upon me in being asked to give an expression of my views relative to problems which are being encountered in connection with the tie situation, but, with the knowledge that there are so many members who could present the matter in a more comprehensive manner, I would have been immensely pleased had the subject been assigned to one more competent, feeling that I am imposing on valuable time.

Few of us give serious thought to the work involved in supplying the railroads with the ties necessary to meet their requirements. An idea of the magnitude of the tie proposition can be gained when it is understood that the annual tie requirements of the railroads of the

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United States are somewhat in excess of 110,000,000 ties.

On the New York Central Lines West of Buffalo we purchased and secured the delivery of 39,384,904 ties during the 8 years from 1910 to 1917, inclusive, which would average as follows: Yearly, 4,923,113 ties; monthly, 410,259 ties.

There is a tie-treating plant at Toledo, O., and one at Indianapolis, Ind. At the former point we endeavor to treat between 1,500,000 and 2,000,000 ties and at the latter between 750,000 and 1,000,000 ties annually, and, in addition, we have a small number of ties treated each year at Trenton, Ontario, Canada. These ties are secured from 12 States and the Province of Ontario, and do not include the large number of ties used each year on the New York Central Lines East of Buffalo. These ties are either rafted or moved on barges on the rivers and streams, or are loaded on cars at stations along the various railroads.

I have spent the greater part of the past 6 months in looking into conditions in the tie-producing fields of several States, and regret that I am forced to admit that, owing to the past and present heavy demands for forest products, the supply is diminishing to a noticable extent, which of course, appears more serious owing to labor shortage. Under prevailing conditions in the way of inadequate transportation facilities and adverse labor conditions, the situation is complicated. Labor is the most serious problem. We must stimulate production, but cannot attain the desired end without giving all necessary consideration to the means. Attracted by the higher wages being paid in the northern central, eastern and western cities, there has been, for a few years past, a constant migration of both white and colored laborers from the tie-and timber-producing fields. Our entry into the war has, of course, had its effect in reducing the labor supply.

The saying has been often repeated, "that there is no better way of judging the future than by the results of the past;" but under existing conditions this rule is impractical of application, as we cannot, in providing for future requirements, anticipate or figure with any reasonable degree of accuracy on account of inability to consistently compare present with past conditions. At no time in the history of our Nation have we experienced such conditions.

The fact is being each day more firmly established that labor is the standard of all values. One may possess vast acreage of the most choice standing timber, but unless it is possible to secure labor to manufacture it into the finished product, it is of very little value. Under normal conditions some tie contractors purchase most of their ties from those who own and produce them, being able in this way to take care of their requirements, while other firms doing business on a

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large scale find it necessary to own the standing timber and finance the manufacture of the ties.

So many woodsmen and farmers have answered the Nation's call, that there is sure to be a great shortage of tie-makers, emphasizing the necessity for producing a great many more sawed ties, which. will, of course, make it necessary to resort to the use of a great many more portable sawmills. The greater portion of the production will have to come from manufacturers who own their stumpage and who will be forced to attract labor into the manufacturing of ties.

Years ago, when the laborers from abroad competed with us in this country, we felt that their presence was an invasion on our rights. Today, however, the immigration is shut off by the war, and we miss that class of labor in performing laborious work.

We owe our country everything we possess, and if we fail to protect the source from which these good things flow we are not good citizens. Fail to fertilize the soil, and we will not secure abundant crops; neglect to keep our homes in habitable condition, and resultant privations will confront us. What is true of the soil and true of our homes, is surely the same with the Nation. Nothing will continue to produce good things indefinitely if the source is neglected. We can subscribe for Liberty Bonds, donate liberally toward Red Cross and other funds, but we are not doing our full duty if we do not constantly endeavor to raise labor to the highest state of efficiency.

It is generally necessary for tie dealers to realize on their product within a reasonable length of time in order to meet financial obligations. When they cannot do this, they have not the incentive to encourage the production, which of course has a depressing effect on the manufacture of ties.

Certain kinds of freight are being embargoed in order to give preference to the movement of essentieals, and the non-essentials are being allowed to accumulate. Ties cannot be considered non-essential at any season of the year, particularly when the enormous demands for them are considered, it being necessary to keep them moving at all times so as to have them available for use when needed.

Through inconsistent and unreasonable legislation the railroads were just about strangled when our good Government was brought to the stern realization that, as avenues of progress, the railroads were indispensable to the success of the nation.

As a railroad employe, I feel that not only the management of the roads we have the honor of representing, but also our Country is greatly concerned in the successful operation of the railroads, and if we fail to render the most efficient service of which we are capable,

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we are not only negligent in the duty we owe the railroads by which we are employed, but we are disloyal to the Government.

Individually and collectively there are no more loyal or patriotic men than the members of the American Wood-Preservers' Association, and we are all greatly interested in the success of the railroads. Considering the large tie requirements and the absolute necessity for having them supplied, I am satisfied that the problem can be solved to some extent by securing greater efficiency from the available supply of labor.

For many years past we have been favored with abundant crops and peaceful times and have enjoyed the necessaries of life without any great effort or sacrifice on our part, which has made us inprovident and has had a tendency toward making us idlers,—we must experience the bitter to enjoy the sweet. Some wise sage coined the phrase "that an idle mind was the devil's workshop." The trouble seems to be that his satanic majesty is operating too many shops and is doing it in the face of a very serious coal shortage.

In conclusion, I wish to state that after viewing the situation from every conceivable angle, I feel that it is eminently proper, appropriately just, and also a patriotic necessity for each of us who is employed by railroads to secure ties and timber as well as those engaged in actual production to feel it a conscientious duty to give the matter serious thought and incessant attention in order to obtain the best possible results. "Efficiency" should be the watchword of this organization,—it should be the National motto (applause).

THE PRESIDENT: With the good start Mr. Shanesey has given us, I have no hesitancy in calling on Mr. Walsh, of the Walsh-Griffith Tie Co., to let us know something about conditions in the Middle West.

MR. P. R. WALSH: Mr. President and Gentlemen: This is rather sudden to call on me.

THE PRESIDENT: You handle many ties, Mr. Walsh, and I am sure you can tell us much.

MR. P. R. WALSH: The conditions at this time are such that it is almost impossible to tell you about them. The production of ties in the territory in which we are operating is about 25% of normal, and I do not think it will be normal during the coming year. In our organization 25 salaried employes have joined the colors. Of course, there are others who have taken their places in a way; but all over the territory a large number have been either drafted or have enlisted.

The price of lumber has increased about 75%; in fact, there is now being made into dimension stuff timber that is actually too small

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to make a tie. We have five mills sawing ties. A representative of one of the concerns in St. Louis that has a contract with a company to build some cars came in the other day and wanted some oak car stock 4½ ins. by 5½ ins. by 8 ft. long. He offered to pay $32 a thousand for that stuff loaded on the car. That is just about two-thirds of the amount of timber in a tie. In other words, you can take a stick that would make two ties and you could make four or five of those pieces and get better than $1.00 a piece for timber now going into ties.

Every little mill in the country is busy and cannot get help enough to run. It is almost impossible to state just what the conditions are going to be. We have had mule buyers in our section of the country, and they are still there picking up all the mules at all fit for service, paying prices for them unheard of before.

It has gotten down to a point now where, on the terms of most of our contracts, it is a losing proposition, to say nothing about the additional expense the contractors have been put to. Labor has advanced. We were formerly paying 10 to 15 cents a tie, and we are now paying 15 to 25 cents. Hauling is a problem with only about 25 per cent of the former number of men and teams, and these of a much less efficient type. Wherever they can possibly be worked, trucks have to be used to haul ties. We will all be forced to that very soon. The only salvation for the timber men is for the railroads to help them out. The railroads were all saying they were so poor they could not pay their bills. Now Uncle Sam has stepped in. Now they say they cannot do anything, because Uncle Sam has got hold of it and there is nothing for the tiemen to do but to gather up what they can and try to live through it.

There is another bad feature in the tie business. Every railroad has a different specification and none of them lives up to it (laughter).

There is another thing, Mr. President, that I would like to say. I have attended these conventions for several years. We have listened to our great men here tell us about the different processes of preserving timber. You all have good ideas, but in the territory in which I have been operating millions of ties could have been cut where the trees are dead—gum, maple, elm and other kinds of timber. They are doing this today in Southeast Missouri and Northern Arkansas. I presume there will be timber equal to the amount required for 2,000,000 ties dead in the next two years. With a drainage tax on the land of $1.00 to $1.50 per acre they are forced to get the land under cultivation. I believe that the Wood-Preservers' convention should lay a great deal of stress on this point for the benefit of the railroads, and work out some plan whereby they could treat all those woods to make good ties.

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When you come to figure out that we have over 100,000,000 ties for maintenance per year, as the previous speaker said, we need very nearly 3,000,000 acres a year, taking into consideration the average yield per acre of tie timber. We ought to begin to conserve timber. Had I known I was going to be called upon I would have gotten out some figures that would have made my remarks more intelligent than this offhand talk with you (applause).

THE PRESIDENT: We would be very glad, Mr. Walsh, to have you contribute any figures or facts that you would have contributed had you gotten more notice. We certainly appreciate getting your version of this particular problem. Most wood-preservers must have cross-ties, and if conditions are as unsatisfactory as you see them, we have something to concern ourselves with.

MR. P. R. WALSH: If these conditions continue and the railroads are unable to furnish cars to handle the output of the tie producers they will only force some of them out of business.

THE PRESIDENT: You feel that a higher price should be paid?

MR. P. R. WALSH: Well, the cost of production has increased over 75%. The year before the war we were buying corn for our mules at 60 cents a bushel, delivered. The last carload I bought cost $1.90. Hay is $32 a ton. It would be reasonable, I think, to consider that some of those things have to be worked out. We unfortunately have a great deal of timber, and we are not only giving our timber away but something else with it. I may be alone in this opinion, but I think there are others who are quite like me, just hanging on hoping for something better.

THE PRESIDENT: We have with us this afternoon some of those connected with railroads who buy cross-ties; perhaps they can hold out some hopes to producers of ties like Mr. Walsh. I see in the back part of the room Mr. Clifton, Lumber Agent of the Baltimore and Ohio Railroad, who from the wealth of his experience in handling his problems can enlighten us.

MR. W. H. CLIFTON: Mr. Chairman and Gentlemen: I did not know that I was going to run into a call for a talk. This ground has been pretty well covered, and I do not know that there is very much I can add to it. I do not know what Mr. Shanesey's experience has been in the last few months in regard to obtaining a sufficient supply of ties, but I know that we over East are confronted with a condition that we have not yet found a means of solving. There are not sufficient ties being made in territory tributary to our right-of-way to meet our requirements.

In the last two or three years we have been compelled to go farther

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afield until now we are operating in territory that we used to look on as foreign. The things that brought this about have been, of course, the war conditions and the drawing of the labor from the producing territory. I was talking with a man coming over on the train last evening who cited an instance of a farmer with five sons who, during the winter months, worked in his or somebody else's woodlot making cross-ties, mine-props and other similar items. Two of his sons have enlisted, and three of them are in the draft. He will probably get one of them exempted on account of the agricultural feature, but four men out of that one family have been taken from the manufacture of cross-ties and similar items. That is not an isolated case. It seems peculiar when you travel about through the tie-producing territory that so large a percentage of young men from that territory have been either drafted or volunteered. It does not seem so noticeable in the cities, but when you get out in the producing field slight inquiry will bring home to you the fact that the Nation is drawing young men who are physically capable from the entire field. Of course, a good many prior to the war had gone into industrial pursuits that paid greater money.

All of that results in a shortage in tie production, and that together with the increased cost of the production due to higher labor costs, higher costs of feed and transportation, makes it necessary for us in some way to assist the producer and the tie contractor bring out a greater supply of cross-ties by increasing the price. We all feel there is a limit beyond which we cannot go, but I have not get found anybody who definitely stated what that limit is.

THE PRESIDENT: Mr. Bowser, you have had a great many cross-ties to procure. How do you feel about the situation?

MR. E. H. BOWSER: I have a great many to secure, but I have not secured many this year. It is a mighty hard proposition. Of course, it would depend on the territory as to what percentage the ties have gone up. In the territory in which we get our ties they have not advanced anything like 50% as yet—somewhere between 35% and 40%. I think in the course of the next six months they will probably go up a great deal more.

THE PRESIDENT: Mr. Pooler, would you mind favoring us with your experience in this direction?

MR. F. S. POOLER: Mr. President, I have listened with a great deal of interest to the arguments that have been put forth by the producers in favor of higher prices. Of course, prices are higher. There is no use disputing that, but there are some arguments to be presented on the side of the consumers. For instance, we must remember, in the first place, that railroad companies, so far as ties are concerned

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at least, are laboring under the same difficulties that the producers are so far as labor is concerned.

Last year we were able in July to reduce our annual estimate of ties needed about 450,000 over what was called for in our estimate which was made the previous September. This year we are endeavoring to add to the stock of ties now on hand sufficient to make up the same number that was actually used last year. In some cases, notwithstanding the unfavorable conditions, we have already been able to accomplish this. There is no doubt but that the use of ties during the war period is going to be considerably reduced, because we cannot get the men to put them in track. I am not saying the roads do not need the ties, but we are trying to get along with a less number simply on account of the labor proposition. That is the main thing, and, of course, transportation is another important consideration. We are, as far as possible, sending our cars to bring ties to our road from connecting lines, but it is impossible at this time to make any promises in regard to that. We are able in some cases when the connecting lines raise their embargoes to get some of our empties to the tie country, and they are being brought back loaded with ties; but the conditions, both on the part of the producer and the consumer, are unusual and they are certainly bad.

I believe that the reduced consumption of ties will to quite a degree offset the increased difficulties of production, and so far we have not found any difficulty in buying the number of ties that we need, with the exception of cedar ties, which are held at rather higher prices than the hardwood ties. We can undoubtedly buy the requisite number of cedar ties, but they will be at an increased price compared with the hardwood ties.

One of the main things that we have tried to do this year is to buy our material from sources where we would be likely to get it. The reliability of the producer, his resources and facilities are important factors in the purchase of ties this year. Of course, this year, as in most years, the greater portion of our ties has been bought from the larger producers, and while we take ties from anyone who offers them at our price, yet a great majority of the ties are produced and supplied by men who have large resources.

THE PRESIDENT: Mr. Moore, Lumber Agent, of the Pennsylvania Lines West, we would like to hear from you.

MR. H. H. MOORE: I believe I can add nothing to what has been said, as the ground has been so well covered. I have just made a trip through central Tennessee where I found many tie contractors turning their stock on pastures because they could not afford to haul ties at the present price of grain. The car question, of course, enters

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into it. We feel if we could get the cars and our inspectors to meet at point of loading without loss of time, we would clean up the entire field in about four weeks. We are having trouble the same as the rest in getting ties. At present we are not receiving any. We are sending our own cars down. Part of the cars have gotten down, and part of them lost.

THE PRESIDENT: I suppose everybody is aware that it became quite general practice during the past year for roads in the northeast to send cars long distances for ties. Mr. Joyce, would you mind, from the standpoints of both a buyer and a seller of ties, telling us something on this subject?

MR. A. R. JOYCE: Mr. Pooler said something that interested me. We have an operation in northern Michigan for cedar ties and hemlock ties, and the ties we have gotten this year are running a little less than 50% of what they ought to run, and the production will be about 50% of what it ought to be. That condition, as far as we can determine, is general throughout northern Michigan, Wisconsin and Minnesota.

The result is that a lot of those roads up there will take cedar ties, for instance, instead of hemlock and tamarack ties. That is, the local roads in that territory are taking ties this year that last year they did not want, and that fact, combined with the car situation, makes it increasingly difficult for a road not tributary to that territory directly to go up there and get ties that were available last year and the year before, and so on. That is an angle of the problem that affects both the producer and the man that wants to get his material.

Now, last year there were a number of producers of cedar ties in northern Michigan that sent their ties East all-rail, and the prices they obtained f. o. b. cars at the loading point were probably 20% in excess of what they expected to get. That is, the eastern roads saw a chance to come into that territory and get that material, and the roads that normally get that material were laying back and they got caught. It is not a question altogether of the producer trying to get the railroad companies to pay him the necessary price, but it is also a question of the railroad company knowing where some material is and arranging to get it.

MR. M. J. FRENCH: I have been very greatly interested in this discussion, and especially to hear of the experience of the main-line steam men. It is an entirely foreign field to me at the present time. A few years ago I was engineer of maintenance-of-way on an electric road that parallels the New York Central Lines, and it almost made our section men cry to see the ties that the steam-road men burned up. That is a matter of economy that you people can well look into. With

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the necessity for tie conservation at the present time I think you could afford to send your division engineers out over your lines to inspect your ties that need to come out rather than leave it to the average ignorant foreman.

MR. J. H. WATERMAN: I promise you I will not talk on every subject (laughter), but I think, as wood-preservers, this is what we ought to do. We ought to show the management of the railroads how to make one tie go as far as two now go. That is our business. If we can do that we will not have to have so many men in the woods making ties, and our friend will not have to buy so many tons of hay and so many carloads of corn. What are we here for if not to conserve timber? Who has said anything about conserving timber? You tell where it goes to, you tell how many million ties we use a year, and he is very low when he says 100,000,000, because in 1913 they used 140,000,000 in this country.

Last fall I had the pleasure of going over an eastern road. I was astounded when they told me that they renewed 20% of their ties every year. In other words, the average life of their ties is five years, and I am here to tell you it is less than five years. That railroad has something like 2200 miles of track, 1300 miles of main line, principally main line. The balance of the railroad is side tracks, and what they term industrial tracks.

Now, you know and I know that in the side tracks and industrial tracks ties last more than five years, so the main-line ties must come out in three and four years, and thousands of them come out in three and four years. How can you overcome that? That is up to the engineering department. Mr. Rex said at one of these meetings that it is up to us, and I believe it is. I would like to have somebody here, who knows something about maintaining a railway tell us how we can conserve our ties. They say we cannot get them. They say if they get them they cannot get them in the track. What is the next question? The next question is to make one tie go as far as two. I expect to do that, and I think Mr. Rex can tell us how he does it. He does it.

MR. A. L. KUEHN: I had not intended saying anything, but there have been just told such a lot of hard-luck stories, that I feel I ought to mention some of the bright spots.

About a month and a half ago, I talked with several engineers in charge of maintenance of important railroads about the immediate prospects for their tie-supply. In the discussion I asked them what their present condition of ties in the track was. Each of these roads started to treat ties some 8 or 10 years ago. Without exception these men said their tie condition today is better than it ever had been.

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This was due to the fact that they had been using treated ties. One man said, "We will have a perfectly safe railroad for two years; even if we do not put a tie in the track, we are fixed." If that is not doing something to help the situation, I do not know what will, and wood-preservers did it.

MR. F. S. POOLER: This discussion is getting so interesting that I must apologize for getting up again. This subject of conserving our ties and making them last longer is something that is very much more interesting to me than the preservation and treatment of timber or even the purchase of timber. I want to say on our road I have devoted some time to this very thing. One thing that I have done—I have to give my personal experience—I have been over a good many of our divisions with the roadmaster on a motor car, and we have stopped and talked with all the section foremen. We have started a campaign of education among section foremen and extra-gang foremen, and we have shown them ties which they have taken out of track which should not have come out of track, and we have shown them ties that are marked in the track to be removed, which should not be removed. I am sure that on some divisions we are making a very much better showing on that account.

The other day an order came into my hands for a lot of crossing timber. Those are good, big pieces of timber, 8 ins. by 10 ins. I had no difficulty at all in getting these in second-hand timber from the Bridge and Building Department. They are taking out that kind of stuff all the while. It means the work of a saw to saw them in most cases, but that can be done. Very recently I visited our shops in Milwaukee, and found there a lot of bridge timber that had been taken out of a bridge, and there was a saw within 10 ft. of it. We are sawing those timbers and making narrow-gauge cross-ties. Those timbers happened to be 8 ins. by 12 ins. by 12 ft., so that each one made four 6 ins. by 8 ins. by 6 ft. narrow-gauge ties.

We bring in old ties to certain points and break them up with bulldozers for engine kindling. We have a lot of ties piled up there now, and we are going to get a saw and saw off the ends of a lot of those ties, especially the cedars, and make narrow-gauge ties out of them. I do not believe we will have to buy a single narrow-gauge tie this year.

I am sure that railroads can do very much more than we have been able to accomplish so far, if a systematic effort were made, and if enough men were supplied or available to go over the road and have a closer supervision of the ties that have been taken out of track. I am aware that this is a subject that perhaps does not belong directly to the American Wood-Preservers' Association, but certainly from the

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conservation standpoint it is a very important subject indeed. I am sure it will appeal to every engineer of maintenance of way present, or anyone who is interested in the track. Better tie-plates should be used—thicker tie-plates, larger tie-plates. After you treat a tie with creosote it is a crime to put it in track without a good tie-plate on it, and cedar ties should be tie-plated. We have taken cedar ties out of track that had been in 32 years on our light lines, and we have cedar ties in track today that have been in over 40 years, where the mechanical wear is very slight. The protection of your material, the close surveillance of the material, is what should be done.

MR. F. J. ANGIER: Mr. President, I agree with Mr. Pooler that treated ties should have tie-plates. I would like to ask him how we are to get tie-plates at the present time.

MR. F. S. POOLER: It is impossible.

MR. F. J. ANGIER: If it is impossible to get them we will have to put treated ties in track without tie-plates. We will do that to some extent this year. Mr. French spoke about buying ties after they had been taken out of track and considered of no further use by the railroads. I am sure that he would not be willing to pay very much for ties taken out along the Baltimore & Ohio. For the benefit of those who are not familiar with our organization it may be of interest to know that we have what we term a Supervisor of Tie Removals. He has four inspectors, and it is their duty to make an inspection of all ties taken out of track. When the section men remove the ties from track, they pile them in small triangular piles along the right-of-way. The inspectors come along at frequent intervals and look them over. If, in the inspector's judgment (who, by the way, is a competent and experienced section foreman), any tie will give further service, they are marked to be put back in track. If no further use can be made of them they are marked to be burned. This work has resulted in saving a good many ties, but it is not the intrinsic value of the ties that makes it worth while; it is the moral effect on the section men, the knowledge that they are being watched and checked up makes them more careful and watchful not to take out ties that will give longer service.

MR. W. H. CLIFTON: Mr. Chairman, Mr. Angier was too modest to say that this tie-removal supervisor was his own idea, and he is working under his direction, and it was under his direction that the work was done. Nevertheless that is true. I have had the opportunity to get around over the line a good deal and see some of the work. The supervisor is referred to by some, facetiously, as the coroner, who, when the tie is reported deceased and removed from the track, is called in to sit on the remains. If he decides that ties

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are not dead he orders them put back in the track or moved to some point where they can be of service. No tie can be burned or buried until the proper burial certificate is issued.

THE PRESIDENT: The general plan outlined for the Baltimore & Ohio Railroad is in effect on other railroads, as most of you know. While Mr. French may have seen some ties thrown out and burned that he might have used, I doubt if he would find that as common as all of us hope it is not. I think that for most of the railroads it can be said that if Mr. French or any other user of wood in the form of a tie would come and offer anything for the ties that have been taken out, he would very likely be able to buy them for 5 to 10 cents—certainly much less than the dollar he is probably paying for new ties.

In connection with coal conservation an effort is now being made in several States by local officials interested in fuel administration to have the ties taken out of railroads made into fuelwood instead of being destroyed. The ties are generally burned alongside the track because the railroads find the cost to handle them or convert them into any other commodity is greater than their sale value.

As Mr. Pooler says, ties are made into kindling for locomotives. There are places, however, where there seems nothing to do with ties except to destroy them. For Mr. Walsh's encouragement it might be said that, although Mr. Waterman dwells on the fact that two ties are being used where one should be, the 50% cut in consumption which will result when they are all treated will be counter-balanced by the growth of our railroads. The money saved by wood-preserving will buy more ties to extend their lines, and the tie dealers will still be in business. Would anybody else like to be heard on this subject?

MR. P. R. WALSH: A great deal of what has been said is quite true. I spent about 15 years of my life in the maintenance of railroads. I was connected with one of the big railroads from 1890 to 1898. During that period we went through a pretty tough time. The particular division that I was on got along during three years of that time with one-third of the ties in their regular allotment.

We all know that we can take a tangent track and by keeping up the low spots, through tamping ties up with bars instead of raising them on the face, make the ties last a great many years after they have been condemned. Of course, you have to keep your curves in pretty good shape, but it seems to me that during this period at least, and for all time to come, the railroads have to begin to use all tactics to preserve the ties in track as well as preserve them before they are put in track. I know it can be done as Mr. Pooler says, and they can get along for the next two or three years if they have to with one-third of the ties of their regular requirements, but by so doing

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they cannot do much ballasting for the reason should the track be lifted out of face soft ties that would, if allowed to remain in their original bed, maintain their usefulness for six months or a year, would drop out and have to be replaced.

THE PRESIDENT: It would seem from what we have heard that there is apparently a shortage in the stocks of raw cross-ties and that the buyers of them are feeling that perhaps more money may have to be paid in order to increase the production. It goes without saying that the members of this Association, in order to keep their plants operating, are much concerned about the quantity produced. They are prepared to do their part in the way of so treating the ties that the maximum service will be gotten from them. The Association has always stood, not only for treating the tie with preservatives that would make it last, but also for such other handling of the tie as would protect it in the track and cause it to give service which would render to the railroads the biggest return for their investment. If nobody else would like to say anything on this subject we will proceed to the consideration of the committee report on the Purchase and Preservation of Treatable Timber, Mr. A. R. Joyce, Chairman.

MR. A. R. JOYCE: Mr. President, I move you that this be adopted as standard practice.

STANDARD PEELING FOR POLES AND PILES. *All round timbers shall be thoroughly peeled before treatment. No piece shall be considered thoroughly peeled unless all of the rough bark and at least 80% of the inner bark shall have been removed. In no case shall any piece of inner bark be over ¾ inch wide or over 8 inches long, and there shall be 1 inch of clean wood surface between any two such strips.*

Should the strips of inner bark remaining on the pole be less than ¾ inch wide, then the clear space required between any two such strips may be proportionately less than 1 inch.

Any cross-section measured in circumference having more than 20% of its surface covered with inner bark, shall be replaced, although the entire surface of the pole may contain less than the allowable 20%.

MR. CARL C. CRAWFORD: I second that motion, Mr. President.

THE PRESIDENT: It has been regularly moved and seconded that the recommendation for standard practice read by Mr. Joyce be adopted. We should have some discussion of matters as important as this. Mr. Taylor, you have to inspect piles and poles occasionally—have you anything to say?

MR. C. M. TAYLOR: Round timbers exclude ties, do they?

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MR. A. R. JOYCE: It does not refer to ties.

MR. C. M. TAYLOR: I think it might be a little more clearly expressed.

MR. A. R. JOYCE: The heading is, "Standard Peeling for Poles and Piles."

MR. C. M. TAYLOR: Do you know whether any road or any association is buying under that clause at the present time? Is that more rigid than the general practice at the present time?

THE PRESIDENT: It is a sort of elucidation of the standard adopted last year. Mr. Joyce might explain further.

MR. A. R. JOYCE: You will remember last year in our standard practice we adopted this recommendation:

> All outer bark should be removed before treatment, and in most cases before seasoning. Also as much of the inner bark should be removed as practical, and in no case should over 10% or strips over 1 inch wide and 6 ins. long be left.

And it was felt that it would work a hardship on the producer, so this was revised to cover the purchase of the piling or the poles, and is suggested as being a more practical specification than the one which we adopted at the last meeting for the treatment of this material.

THE PRESIDENT: Who has ideas on this subject? In considering this specification you should pay particular attention to the details into which it goes.

MR. J. A. JOHNSON: Do I understand that just to refer to piling and poles?

THE PRESIDENT: Yes.

MR. J. A. JOHNSON: The reason I made mention of that, we have had considerable trouble in our inspection with that inner bark. It appears while it is in the timber when they cut it absolutely or very nearly white or the same color as the wood itself, the sapwood, but after laying awhile the timber takes on a very dark color, especially that floated down the stream, and it is very tight. The inner skin has somewhat the action of rubber, and the contractors seem to be of the opinion that when they cut the wood in the timber they get all of that off, and then when the timber comes down the tie inspectors reject them on account of having too much bark, which really is the inner skin. I was thinking if 10% was to apply to the ties, 10% of the surface, it was perhaps a little too rigid.

THE PRESIDENT: That is what the Committee thought in reference to piles and poles; so they have raised it to 20%. This apparently is an attempt to liberalize the standard approved last January

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and since adopted by the Association. This is a revision of a present standard specification, liberalizing the specification and also going into more detail than the former one did.

MR. CARL G. CRAWFORD: During the past year we have treated a good many poles and piling, and have had considerable trouble with consumers regarding this feature of preparing the pole for treatment. One company has demanded that we clean the pole absolutely of all inner bark, which has resulted in practically shaving the pole. Of course, we had to make our prices to cover this extra peeling, which we ourselves considered unnecessary. This caused dissatisfaction among inspectors for other consumers who formerly did not demand that all of the inner bark be removed. Up to this time, so far as I know, there has been no established practice as to just how much of the inner bark should be removed, and I am very glad to see that our Committee has prepared this specification for peeling and recommended its adoption by this Association, which should greatly assist in standardizing this work. I hope the Association will adopt this specification, or some specification for peeling poles, in order that we may cite it as authority in our recommendations as to just how much of the inner bark should be removed. For some time I have recommended a specification very similar to this one, and I feel that if poles are peeled in accordance with it, the amount of inner bark remaining on the pole will not interfere with the penetration. There might possibly be one exception to this, and that is, where poles are treated absolutely green or are only partially seasoned, before the strips of inner bark still remaining on the pole, have become removed in seasoning. If anyone here has had experience in treating poles so peeled, when they were green or partially seasoned, I should like to have the benefit of his experience.

MR. WILLIAM A. FISHER: In line with Mr. Crawford's remarks I can say that in my experience I have found in treating green pine piling the steaming apparently reduces the impenetrability of the inner skin that is left on, and that the penetration of the creosote is apparently not badly retarded by a reasonable amount of inner skin such as this specification would allow to be left on the piles.

THE PRESIDENT: Is there anybody else with experience who can enlighten the Association on the point raised by Mr. Crawford? If not, are you ready for the question? This is an amendment of the present standard which was approved and adopted last year. It liberalizes the specification and goes into more details. It has been moved by Mr. Joyce and seconded by Mr. Crawford that the Association approve it for balloting by the Association for inclusion in the MANUAL. All those in favor say "aye," those contrary "no." The "ayes" have it.

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MR. A. R. JOYCE: The second part of the Committee's report is a discussion of the mechanical burden of ties.

REPORT OF COMMITTEE ON PURCHASE AND PRESERVATION OF TREATABLE TIMBER.

To the Members of the American Wood-Preservers' Association:

STANDARD PEELING FOR POLES AND PILES. *All round timbers shall be thoroughly peeled before treatment. No piece shall be considered thoroughly peeled unless all of the rough bark and at least 80% of the inner bark shall have been removed. In no case shall any piece of inner bark be over ¼ inch wide or over 8 inches long, and there shall be 1 inch of clean wood surface between any two such strips.*

Should the strips of inner bark remaining on the pole be less than ¼ inch wide, then the clear space required between any two such strips may be proportionately less than 1 inch.

Any cross-section measured in circumference having more than 20% of its surface covered with inner bark, shall be replaced, although the entire surface of the pole may contain less than the allowable 20%.

Mechanical Burden of Ties.

The physical and mechanical properties of the various species of timber suitable for use as cross-ties remain practically constant.

The physical life of the wooden cross-tie may be defined as the period of service up to the point where decay renders the timber inadequate.

The mechanical life of the wooden cross-tie may be defined as the life up to the point where mechanical abrasion renders the timber unsafe for further use.

A careful analysis of the maintenance records of representative railway systems, shows a small percentage of clear cut instances of failure, due to the natural causes of decay, and a small percentage of equally clear cut cases of failure due to mechanical wear.

From most records, the cause of the failure of ties is undoubtedly due to the combination of these two factors.

For example: The sapwood of white oak, which timber is used very largely without preservative treatment, has the same strength as heartwood of like density and moisture content, but is not naturally durable in contact with the soil and exposure to the elements, so that white-oak ties, which contain a considerable per cent. of sapwood, fail, due to

First—Rotting of the sapwood, which lessens the rail-bearing surface.

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Second—Not sufficient timber is left to carry the load.

And, conversely, Douglas fir ties creosoted, which contain a small per cent of sapwood that are not adzed and bored before treatment, or properly tie plated when put in the track, may fail, due to the fact that the heartwood is very resistant to creosote and the grinding action of the rail on the ties breaks the fiber of the timber at the rail seat, loosens the spikes so that moisture and air have ready access to the untreated interior heartwood, and the ties may fail due to

First—Rotting of the untreated heartwood.

Second—The failure of the rotten wood to hold the spikes, and the crushing of the ties under the rail.

There are five factors which have tended to prolong the life of ties:

1. Increased weight of rail.
2. Improved roadbed and ballast conditions.
3. The use of heavy metal tie plates of a sufficiently greater area than the rail base, to more perfectly distribute the train load.
4. The adzing and boring of ties to give more even wearing conditions.
5. Preservative treatment to keep out moisture and prevent fungus growth.

Many of the first metal tie plates used were not only inadequate but were an actual detriment to the timber instead of being a benefit.

Table A shows the rail history on one of the more important railroads of the United States.

TABLE A

Period	Weight of rail *Pounds.*
Prior to 1866	48, 50 and 56
1866-1875	60
1876-1881	65 and 66
1882-1902	75
1903-1909	85
1909 and subsequent	90 and 100

The main line is laid with the heaviest rail, and the branch lines and yards with the lighter rail.

The increased rail base of the heavier rail distributes the load over a greater area on the individual tie, and through the greater weight of the metal reduces the wave action and distributes the load more perfectly over the ties.

The narrow base of the lighter rail, under heavy traffic, causes severe rail cutting and failure of the ties from this cause.

There are four factors which have combined to reduce the mechanical life of the wooden tie, as follows:

1.—The increase in the weight of motive power. In Table B is

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given a statement of the maximum loads on drivers of engines in regular service on one of the large transcontinental railway systems.

TABLE B

Year	Load *Pounds.*	Year	Load *Pounds.*
1850	10,000	1885	16,000
1855	10,000	1890	16,000
1860	10,000	1895	16,000
1865	10,000	1900	22,500
1870	11,000	1905	23,000
1875	11,000	1910	27,000
1880	16,000	1915	32,200

It will be noted that the weight has more than tripled since 1850, and a little more than doubled in the past 20 years.

2.—Table C shows the increase in freight car capacity on one of the important American railway systems in the 10-year period from 1905 to 1915.

TABLE C

Character of equipment *Cars.*	Increases in cubic feet. *Per cent.*	Increases in capacity. *Per cent.*
Furniture	33.64	45.45
Box	18.69	12.82
Stock	18.97	25.23
Coal	39.35	47.54
Ballast	48.66	24.45
Flat	....	36.38
Tank	.....	4.38
All cars	28.76×	32.98

×Excluding flat and tank cars.

It will be noted that capacity has increased in greater proportion than the cubical contents, thus indicating stronger construction, which, in turn has been brought about by a constantly rougher handling of equipment.

3.—The increased load carried per car noted in Table D following:

TABLE D

Year	Load per car *Tons.*
1904	19.97
1905	20.10
1906	20.93
1907	21.46
1908	22.08
1909	21.47
1910	22.11
1911	22.01
1912	22.44
1913	24.10
1914	24.70
1915	24.71
1916	25.83

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4.—The increase in ton-miles, due to the increased density of traffic.

From the data presented, the increase in load to which the wooden tie is subjected, is evident. The reported increase in the use of cross-ties antiseptically treated to prevent decay, has been very rapid during the last 20 years. Many species of timber are now used for cross-ties, by reason of the fact that they are very susceptible to preservative treatment and are available in great quantities. Some of these woods are inferior to the naturally durable woods, such as white oak and longleaf heart yellow pine, in both physical and mechanical properties. There is no question but that they can be antiseptically treated so that decay will not be a factor in their service as ties, but due to their inferior mechanical properties it is of the first importance that when these species of timber are made into cross-ties they be made of a size sufficiently greater than that which is specified for the naturally durable woods, and further, that they be protected by heavy metal tie plates.

As has been shown in Table B, the engine driver load on one railway system has now reached a maximum of 32,200 lbs. This is the dead weight on the drivers, and is augmented by the speed of the train and the angularity of the road. If the ties on this line are protected by a 7 in. × 9 in. metal tie-plate, for example, this means a theoretical load per square inch on the ties of 511 lbs. While the rail distributes this load over several ties and theoretically about one-half of the load is borne by the individual tie, practically almost the full blow of the impact due to the speed, ballast conditions and curvature of track may be obtained in service.

As the fiber stress at the elastic limit of Douglas fir in compression perpendicular grain will average only 530 lbs. per square inch, it is evident that the limit of the maximum load on engine drivers is nearing its end, if wood is still to serve as cross-tie material, under the protection of a 7 in. × 9 in. metal tie-plate. The limit can be extended, of course, as tie plates are made thicker and of greater dimensions. In some woods, such as northern white cedar and western yellow pine, which have a fiber stress at the elastic limit in compression perpendicular to grain of 290 lbs. and 320 lbs. respectively, the limit of engine-driver loads, without tie plates, has already been reached on many divisions on the larger railway systems.

In considering the utility of various woods for ties, attention is called to the method suggested by the Forest Products Laboratory, which is given in detail on page 238 of the 1916 PROCEEDINGS. It is apparent that the formula derived by the laboratory follows very closely the various mechanical properties of the different woods demanded for

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use as ties, and that it may be relied upon as a safe index to the utility of the various commercial woods.

A. R. JOYCE, *Chairman.*
J. B. CARD,
O. P. M. GOSS,
F. R. MARTIN,
GEO. E. REX,
H. S. SACKETT,
M. T. SHANESEY,
LOWRY SMITH,
H. S. VALENTINE,
C. P. WINSLOW.

THE PRESIDENT: Gentlemen, you have heard this report. It presents a way in which the matter of using cross-ties should be approached. It emphasizes the fact that has been repeatedly stressed in the Wood-Preservers' meetings, that is, the mere treatability of a stick is not an index of its usefulness. There have been cases where ties should not have been treated owing to their weakness in structural strength and the treated tie has been blamed for the failure. We certainly would appreciate a general discussion of this subject.

MR. M. K. TRUMBULL: Mr. President, are we to understand that the Committee does not desire to have the five factors making for the prolongation of the life of ties included in the MANUAL?

THE PRESIDENT: Yes.

MR. M. K. TRUMBULL: I wonder whether the Committee would be willing to consider the inclusion of an additional factor in view of the discussion on ties this afternoon, namely, more careful inspection of ties for removal?

MR. A. R. JOYCE: The points that we have brought out are facts. The careful inspection of ties before removal might be called a fact of equal importance, but could you compare it with the additional weight of the rail as the same kind of a fact? We call your attention to the fact that the additional weight of the rail has been a factor that has aided in prolonging the life of ties. Would you compare that with the fact that a man uses good judgment, good management and does not take a tie out before it ought to come out? The two facts do not appear to me to be on the same basis. A man ought not to take a tie out before it is ready to come out. Some sectionmen do, but it ought not to be done. Now then, all the roads are using heavier rails, and that is one factor that very generally has aided in prolonging the life of ties.

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MR. M. K. TRUMBULL: I merely raised that question to determine whether the Committee cared to consider it.

THE PRESIDENT: With my advantage over those in the audience who have no copy of the report to follow, I think I can appreciate why the Committee has submitted this as information only. There really is nothing in the way of a standard for the MANUAL among the five reasons why ties have lasted longer than was the case formerly.

MR. M. K. TRUMBULL: It was not so much a question of advocating that this be put in the MANUAL. I was asking whether it might not be well, since they were outlining the factors which tended to prolong the life of ties as an abstract question, to add this as one of the factors, namely, careful observation of ties before removal.

THE PRESIDENT: If all ties were carefully looked over before being taken out of track they would last somewhat longer, because some undoubtedly are taken out too soon. Any discussion of this paper? It is unfortunate it had to be delivered without having been printed in advance, for there are in it figures which would have suggested inquiries and discussion. I will be glad to entertain a motion from somebody to accept the latter part of the report as information.

MR. M. K. TRUMBULL: I move it be accepted as information.

MR. J. H. WATERMAN: I second the motion.

THE PRESIDENT: It has been regularly moved and seconded that the portion of the report bearing on the mechanical burden of ties be accepted as information. All those in favor say "aye," contrary "no." It is so ordered.

We will now have the report of the Committee on Promotion and Education. I will be glad if the members of that Committee who are here come to the platform, and will ask one of them to read the report in the absence of Mr. Sterling. Mr. Schnatterbeck is the only representative of the Committee here, and we will therefore ask him to read the report.

MR. C. C. SCHNATTERBECK: There are no further comments to make with one exception. We hope all the members will co-operate in the effort to make our magazine the sponsor for the industry. WOOD-PRESERVING is struggling to propagate the principles of our Association, and we hope that all will give it a lifting hand and do what they can to further the interests of our industry through this vehicle of publicity. I trust everybody will unite to support our publications in the interest of our Association and for the benefit of its members. I thank you (applause).

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REPORT OF COMMITTEE ON PROMOTION AND EDUCATION.

To the Members of the American Wood-Preservers' Association:

Last year your Committee on Promotion and Education submitted a report embodying definite recommendations for an educational and promotion propaganda on behalf of wood-preservation. This report outlined under specific headings certain work which could be profitably undertaken by the American Wood-Preservers' Association, by the individual members, and by the Committee. This year we have nothing new to add in the way of recommendations or suggestions, and regret that conditions have been such that the recommendations made could not be carried out.

It is generally recognized that publicity work on behalf of an industry cannot be effectively conducted by voluntary effort without funds. Much, however, has been accomplished, and under normal conditions your Committee would have been able to put into effect during the past year some of the recommendations which were made. These, however, are largely dependent on the cooperation of individual members in furnishing news items, and in giving personal time to direct educational work.

Under the stress of war conditions and the diversion of effort and energy to new lines, the facilities and energies have been transferred so largely to government work that probably the usual thought has not been given towards permanence of construction. This, perhaps, should have led to greater educational effort if the material and the facilities had been available.

In the lumber industry a special campaign has been inaugurated for the purpose of stimulating farm and home building; while the competitive cement industry has continued its extensive publicity work. In both of these cases, however, well equipped and adequately financed organizations have done the work, and little could have been accomplished in either of these industries from voluntary effort.

The members of the Committee who have been heard from are unanimous, with one exception, in the sentiment that the past year has been an inopportune time for constructive publicity effort. One of the members "assumed that the present trying conditions are too unfavorable to justify much of an attempt towards pushing our line, "while another feels that "unless the members of the Association show some real interest and willingness to cooperate in publicity matters" and "until the commercial timber-treating engineers realize the value of publicity to the extent that they are willing to take the lead in matters of this kind, * * * there is little hope for anything being accomplished." In the one exception noted, the member took the stand that

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"we should not let the interest in the wood-preserving industry suffer by circumstances that affect all industries sympathetically."

This obviously is not in the nature of a formal Committee report, but is rather an explanation which, under the abnormal conditions existing, the Committee hopes the Association will accept.

E. A. Sterling, *Chairman.*
John S. Bates.
Nelson C. Brown.
F. V. Dunham.
E. T. Howson.
S. J. Record.
P. S. Ridsdale.
C. C. Schnatterbeck.
O. T. Swan.

THE PRESIDENT: You have heard the report of the Committee. It does not go into any details, but it does stress the point repeatedly made, that the individual efforts of every member of the Association are necessary if there is to be gotten together for publication and the promotion of the industry the facts to make people think about wood-preservation. You know something and the man in the adjacent plant knows something, but you keep it to yourselves. Those in the direction of the Association who have attempted to do anything along the lines of publicity or publications know how hard it is to get anything from the general run of the members. Will somebody move that we accept this report?

MR. C. M. TAYLOR: Mr. President, I move it be accepted.

MR. WILLIAM A. FISHER: I second the motion.

THE PRESIDENT: It has been regularly moved and seconded that the report of the Committee on Promotion and Education be accepted as information. Those in favor will say "aye," those opposed, "no." The motion is carried.

Has anybody other business to bring before the meeting? If not, we will adjourn till 10 o'clock tomorrow morning.

An adjournment was then taken till 10 o'clock, January 23.

WEDNESDAY MORNING SESSION.

January 23.

The meeting was called to order at 10:30 A. M., by President Foley.

THE PRESIDENT: Mr. Secretary, are there any communications?

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THE SECRETARY: A telegram from Mr. Goltra, of Cleveland:

Fraternal greetings to you and fellow members. Profoundly regret inability to attend first convention have missed in 10 years.

THE PRESIDENT: First on the program this morning is "Fire Protection as Applied to Wood-Preserving Plants." We will be addressed on that subject by Mr. J. G. Hubbell, Manager of the National Inspection Company. Mr. Hubbell's experience with special risks in fire insurance promises to help us in becoming acquainted with this important problem. Mr. Hubbell (applause).

MR. J. G. HUBBELL: Mr. President and Gentlemen, I would rather talk than present a paper, but if one tries to do that I have found he is very apt to overlook some point that afterward he wished he had brought out. I do not know that I am so very keen to talk about the fire insurance end as I am the fire prevention and fire protection end of the business. I prepared the paper with this in mind. I am an inspector. That is my business. The concern I represent goes over the Central West, and we have inspected most of the larger plants in that district in the last few years.

In the matter of fire insurance I would hesitate to advise you, because individual people have their own ideas as to how to adjust their insurance matters and how they want their insurance matters looked after. In accepting the invitation to come here, which is a compliment I feel, I have devoted my thought to setting out a method of running these plants so you will not have many calls on fire insurance companies for settlement.

FIRE PROTECTION AS APPLIED TO WOOD-PRESERVING PLANTS.

By J. G. Hubbell.

The first factor in fire prevention is orderliness, not only in the administration of the property but in the arrangement of the plant. A congested, mixed up layout is expensive to operate, and hard to keep clean. Danger spots will lurk about such a property all the time, for the reason that you are dependent on a rather rough grade of employes, and it is through them that the cleaning and keeping in order has to be done. Owners are slow to do it, but it pays to rip out and tear out and rebuild when it develops that a plant is too small for the work it has to do. A fire will likely compel a shutdown, and it is well to arrange a shutdown intentionally rather than have it forced upon you.

The average wood-preserving plant is made up of two elements: the operating and administrative buildings, and the storage yard. Whether railroad ties alone or railroad ties and lumber are handled,

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the yard is a type of lumber yard and should be constantly regarded as such. The essentials of safe administration of such a yard are: First, sufficient room; second, good roadways and lanes between the piles; third, a clear space between the yard and any exposing property and, fourth, a clear space between the yard and the operating buildings. Those spaces are regulated. Different spaces will make a different rate of charge. The yard in itself is regarded by fire insurance men as a low-hazard feature. The hazard is regarded as attaching to the operating buildings. If there were a yard alone you would have a rather low rate. As soon as the operating buildings or manufacturing part of the institution is installed it is regarded as increasing the hazard of the yard if it is near enough to the yard to set a fire. Sawmills are required to have a surrounding clear space of 200 ft., and the same in regard to exposures of the same character; but in your property I think that safety would be accomplished with a clear space in some plants perhaps of 100 ft. or 150 ft. surely, because the plant buildings are usually small as compared with the buildings contemplated in a sawmill schedule.

The yard should be kept clear of grass, bark, chips and any material which would catch sparks from a fire in the buildings or in neighboring property or from passing locomotives. The way to keep a yard in order is to assign a man whose duty it is to rake it up and keep at it all the time, picking up scraps and miscellaneous refuse of all sorts. There should be no smoking permitted, and the building of fires to dispose of refuse, the striking of matches, and the use of open torches of any kind for light, should be prohibited. Do not permit the erection in the yard of shanties of any kind. If shelter is necessary for the men at any point, a properly-constructed housing should be provided by the company. If power cranes are used for handling ties or poles, some sort of spark screen on the stack should be provided. These points are very important in dry weather.

The purpose of all these provisions is, first, to reduce the chance of fire starting, and second, to prevent it from making an easy spread once it gets started. If you have a littered yard, and a fire gets under way in it, you will have a hard time controlling it, because other fires will start at so many different points that it will be impossible to prevent the destruction of the yard.

If any considerable quantity of lumber is carried, it is worth noting that lumber which is piled solid, that is, without spacing strips between the boards, so that the pile is a compact mass of lumber without air spaces between the boards, burns very slowly and can be easily controlled. Such piling cannot be used where it is desired to season the timber, but is advisable where it can be used.

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The question of protection for the yard we will take up later, but, waiving that for the present, if the yard is arranged and managed as suggested, there is hardly any reason why a fire should commence there, and, viewed from an insurance standpoint, it should be a low-hazard risk.

In the larger properties we find that the operating buildings are frequently incombustible, made of steel, tile, concrete and brick. In such cases the chance of a blaze of any extent is rather remote. There is no hazard attached to the use of zinc solutions. Wood that has been treated with them does not burn readily, but there is a decided hazard where creosote or similar materials are used. These are derivatives of coal tar, and are very combustible. The lighter oils have usually been removed by distillation so that inflammable vapors are not likely to be given off at ordinary temperatures. When the material is heated, however, there is enough volatile content usually present to make it advisable to provide plenty of ventilation and avoid the use of open lights or fires anywhere about points where hot creosote or other such oils are being used.

The distilling process by which these materials are made, like all distilling processes, is more or less a fractional separation of the different compounds present in coal tar. The expense of making a complete separation of lighter from heavier oils is out of the question, consequently there is almost sure to be a certain amount of lighter product left in the still when the switch-over is made for production of the creosote. These lighter products come over with the creosote oils. The statement is sometimes made to us that you cannot burn creosote, and the point is illustrated by taking some of the material and applying a match to it. It is also true that you cannot burn lard or lubricating oil by the same method; but we all know that after such oils are heated to the point where they give off vapors they burn furiously, and, once on fire, it is hard to put them out with water. Wood saturated with creosote is like wood saturated with any other combustible oil—it makes fine fuel for a fire.

It follows that ventilation and the use of safety lights are necessary to prevent accidental ignition of vapors. It follows also that constant effort should be exerted to keep down the accumulation of oil on the floors, about the pumps, around saturating cylinders and wherever accumulation of the material is evident. The operating building should be kept free from refuse by repeated and constant cleaning just as was recommended for the yard. If bark is removed before the material is saturated, this should be done at some point well away from the operating buildings and from the lumber and tie yard.

The fire hazards of the operating buildings are power, heat and

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lights, repair departments, bearings, and items such as smoking and care of lanterns, employes' coat-room, etc.

The arrangement of the boiler room depends somewhat on what kind of fuel is being burned. There is no particular hazard about coal, provided no great quantity of it is stored in the buildings, and if the boiler and its breeching and stack are well away from all woodwork, giving a free space for ventilation. This should be particularly looked into as there is frequently no proper provision made for ventilation where the stack goes through the roof and the clearance of the roof over the boiler is sometimes too scant.

Where any considerable proportion of wood refuse is burned there is danger of sparks from the stacks, and screens should be provided there. There is also danger of fire getting out of the boilers into refuse fuel on the floor and passing along that to the main fuel pile. In such boiler rooms there should be 10 ft. or 12 ft. of free space in front of the fire doors, and the floor should be kept clear between the firing doors and the fuel pile. Where it is possible to separate the boiler room from the rest of the plant it should be walled off.

If electric power is used motors must be installed with care and be regularly looked after. No motors of commutator type should be used where there are creosote vapors, and controlling switches must be away from vapors or combustible dust. Cleanliness about all motors is essential. All bearings on shafting and machines must be kept clean and well oiled. Do not tolerate dirty bearings. Many fires start from dirty bearings, and the cause is stated to be unknown. The fact of the matter is, the circumstance that the bearing was warm was not noticed and it was smouldering when the plant was shut down. The shutting down of the plant seems to stop the drafts caused by the moving shafting and to favor the increase of heat. We have many cases of this sort, especially in grain elevators where they rely a great deal on automatic journal alarms. This is a device with a closed circuit, a fusible plug inset in the bearing and, when the temperature of the bearing gets above 180° (I believe that is the temperature relied on), it melts this little fuse and breaks the circuit, which sends in an alarm. They have cases of alarms coming in from bearings an hour or two hours after they have shut down, making it evident that something not understood permitted the rise in temperature of the metal supporting the shaft after the shut-down. It is not necessary for the fire to be in existence at the time of the shut-down. There is something there and we do not understand just what it is. It may be simply the slow movement of the heat through the mass of the metal from some point away from the point where the fuse plug was inserted. This probably is the explanation, but they do get alarms as late as two and three hours after the shut-down.

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The blacksmith and repair shop should be set off by itself, or, if part of the main building, it should be walled off. A great many fires start from men's working clothes hung up around steam pipes or in hot corners. Cabinets of steel and a well-lighted room, preferably separated from the manufacturing buildings, should be provided for the men to hang garments in. If heating is necessary every effort should be made to provide steam heat so as to avoid the use of stoves and salamanders, and care must be taken to see that the steam coils do not become banked with refuse of any kind, but are kept free from all foreign material and clean; they must be carried on iron racks, not wood.

Many people do not believe hot steam pipes cause fire. You can prove it yourself. Bury a high-pressure steam pipe in a box filled with sawdust and forget about it. Open it up and you will find it is burned out after a month or so. Such things need to be checked up, especially where the steam pipes come in contact with softwood. Hardwood does not seem to be so subject to this difficulty.

Lanterns are nearly always necessary to some extent for outside use, but lighting in the buildings ought to be by electricity with an equipment installed according to standard specifications. Double globe lamps, with guards, should be provided where vapors are likely to be present, as a precaution against the breaking of incandescent globes.

You break an incandescent globe and it exposes the filament. The vapors are forced in by the pressure of the air. The minute the globe is cracked and before that filament can cool down the vapors will be ignited, if there is anything combustible about it. The switches controlling any lights in such places should be outside of the room. There should be no switches on the lamps used in such places.

The best fire protection is a system of 6 ins. or 8 ins. cast-iron yard mains and standard double hydrants supplied by an Underwriter's pump, or a good-sized tank or by city water, with fire hose housed near each hydrant together with nozzles and spanners. The spanner is necessary because a hydrant nut is five-sided and cannot be operated with ordinary wrenches. Around the treating plant there should be a supply of sand in tanks with scoops for handling, or of pails filled with sand. The 3-gal. chemical extinguisher is a very effective device for fighting fires, but is hardly to be recommended in locations exposed to freezing weather and is not particularly good on oil fires. I have just come across a "Fire Foam" chemical extinguisher, a cart modification of the device recently approved for killing oil-tank fires. If a warm shelter for such a cart is available, such a device would be fine for use in creosote fires.

The yard should be provided with covered water barrels and pails.

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By using calcium chloride in proper amounts, the water in the barrels can be kept from freezing no matter what the temperature. It is my understanding that calcium chloride brine does not sour as does ordinary brine. It is stated that calcium brine seems to cause the barrels to shrink and leak and they should be well dried out, tightened up and tarred before any brine is put into them.

Where reliance is put on fire hose and hydrants there should be at least 100 ft. of hose at each hydrant, and there should be some additional hose amounting to several hundred feet on a cart kept at some accessible location. The employes should be instructed in the laying out and use of hose and of any other fire apparatus.

Do not forget that where nozzles with an outlet of more than ½-in. or ¾-in. are used it requires two men to hold the hose, as the back pressure or kick of a large nozzle is more than one man can control. A tank at 100 ft. elevation will give 43 lbs. service pressure at the ground level, which should be enough to fight fires in such property, as there are no high spots to reach. If the water supply is a high-pressure one, like a city water works or a private fire pump of large capacity, it would be advisable to have nozzle outlets exceeding ½-in. or ¾-in., unless arrangements are made for two men to a nozzle.

The pumps for such a supply must be of large capacity, not less than 500 gals. a minute, if they are to do effective work; but there is no use in putting in a pump larger than the boilers can supply. The stream supplied by an ordinary fire engine requires 250 gals. a minute for each standard 1⅛ ins. stream. With small nozzle outlets the same supply would serve two or possibly more streams, which would be much less powerful but would do very effective work and could be handled by one man to a line. It is the size of the nozzle outlet and the pressure at the nozzle and not the size of the hose that determines the quantity of water flow, provided the hose is not so small as to prevent the nozzle from working to capacity. Large hose is an advantage, as it cuts down the loss of pressure by friction in the hose.

You hear a great many ideas on that subject. People think they get high pressure with a small hose. If you have a large supply line and a small outlet you are bound to get a large discharge of water at high velocity, but the more you reduce the outlet the more the total quantity of water discharged is reduced. If you increase the outlet you increase the amount of water discharged, but you are seeking two things with your nozzle. First, you want throwing power. Well, to get throwing power you must have the nozzle outlet so proportioned to the size of the hose and the supply, whether it is a pump or a tank, that water can be delivered at the base of the nozzle at a pressure

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big enough to throw it somewhere. If you open up the end of the hose by taking off the nozzle you get a tremendous flow of water but you get no pressure. The pressure supplied by the pumps is used up in forcing the water through the flow line at maximum speed and it is discharged at almost no pressure. If you want pressure at the end of your hose line put on a nozzle with a smaller orifice than the diameter of the hose itself. The result is a reduced discharge at high velocity and the hose acts as a pipe or a water main to carry the water up to the nozzle. Be sure to put in 2½-in. hose, no matter what size of nozzle you use, especially if you have low-water pressure, because if you have low-water pressure like that from a gravity tank of 100 ft. elevation you are going to need all the pressure you can bring up to your nozzle. The only means by which you can bring that pressure effectively up to your nozzle is to have a large hose line to carry it there. It reduces the pressure loss from friction. If you use a small hose you will cut 10, 15 or 20 lbs. off your effective pressure in a hose line 150 ft. long, and with all that loss you cannot throw the water anywhere.

Arrangement should be made to have the plant patrolled day and night and holidays. A clock system to keep the watchman going about his rounds should be provided. In choosing a watchman try to get a man of some ability and life. One of the puzzling things that strikes an insurance man as he goes about is the ease with which the owner of property worth thousands of dollars abandons it at night to the care of a decrepit old individual who would be almost helpless in any emergency.

I think you know all I have told you, but, as was remarked to me in talking of this address, we all need to be reminded. Sometimes in the process we get a new idea or a new angle on an old idea which is valuable.

In closing I will say again that the chief point is a forehanded administration of the premises determined that cleanliness and order are enforced at all times. I believe that more fires are prevented by the broom, the rake and the use of brains, than are put out by any amount of fire apparatus that can be accumulated. Fires quite generally go through to the end of the property they get started in regardless of the modern devices usually at hand for combating blazes in such properties. It is better that they get no start.

THE PRESIDENT: Mr. Hubbell, the Association appreciates your coming here. Your paper will be printed in our PROCEEDINGS and thus be a constant reminder of what ought to be done to prevent fires. All operators are not able to do everything that should be done; each

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has to adopt the best method that is feasible under his circumstances. I am sure Mr. Hubbell would appreciate our members discussing his paper, giving their own experiences in the line of fire protection.

MR. J. H. WATERMAN: Mr. President, I would like to ask a question. What would he consider a reasonable rate if we did all he asked us to do?

MR. J. G. HUBBELL: I will have to say I have nothing to do with rating. Fire insurance is a very large business. To the outsider it seems like a single thing, but to a fire insurance man when you say that you are in the fire insurance business he immediately wants to know what particular department of fire-insurance activity you are engaged in. I have been traveling in the field; that was years ago. I have adjusted losses. But most of my life has been in underwriting and inspecting, and it would be presumptuous for me to try to embark in any comment on fire rates. I do not know what you gentlemen are paying. We do not pronounce upon the rate in looking at your plants. We simply look at the grade of management being exercised, and assume that the rating bodies have considered the plant on its merits in comparison with other plants, that it is equitably rated and that, if the grade of management is satisfactory, the plant is a good risk. If the grade of management is unsatisfactory it is a doubtful risk.

MR. J. H. WATERMAN: Mr. President, notwithstanding I had a warning what to do and what not to do, I am going to tell, for the benefit of these operators, what we have accomplished at the Galesburg plant.

It took us a couple years to do it. They sent a representative of the insurance company out to the plant, and he wanted so many things. For instance, he only wanted to pile the ties 10 ft. high, and I wondered what my friend Taylor would do if he could only pile his ties 10 ft. high. He wanted alleys, and he wanted this, that and the other, and I told him, "I can beat your scheme 100%." He said, "How can you do that?" I said, "Why, abandon the yard and then we will not have any insurance to pay at all" (laughter). But after talking for a year or more we got together. They sent a representative out, and we divided up the yard in squares, with 100 ft. of space around each square of 700,000 ft. I think one square is 750,000 ft.—they waived a little on that. We put in fire alleys of 100 ft. in width, and maintained them clear through the yard.

We put a circulating system of 6-in. pipe around the yard. We put in an additional fire pump. We had one that would throw 1000 gals. a minute, and we put in another which would throw 1500 gals., and arranged so we could couple them up. We can work them singly or doubly, and we can throw 2500 gals. of water a minute, if necessary.

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What did we accomplish—how much did we get out of it? They notified us that unless we got busy and made those changes our rate would be $1.18. We made the changes, and the rate is 59 cents. With 2,000,000 ties in the yard, you rapid calculators can tell what we save in a year. It soon pays for itself.

MR. J. G. HUBBELL: I think that is splendid. The business is more secure from interruption, which, as a fundamental feature, is sometimes overlooked by business men. The question of rate is annoying. Any tax is, but the essential point is to get your business so arranged that it is not going to be interrupted by fire. Your business is worth more than all insurance premiums you pay in several years.

THE PRESIDENT: Will not some operator of a commercial plant speak on this subject?

DR. HERMANN von SCHRENK: Mr. President, I wish simply to express my personal appreciation of Mr. Hubbell's paper, particularly his insistence on what might be called a moral hazard as distinguished from the material hazard.

A few weeks ago I received a contribution from the National Fire Protection Association, published in one of its forthcoming numbers, entitled, "Fires at Creosoting Plants." The entire paper was practically devoted to a discussion of fires which had occurred at creosoting plants in the last 25 years in the United States, and gave me, as I judge others, the impression that the creosoting plant was about the worst kind of fire hazard there was anywhere in the United States. I proceeded to criticize this paper. I made a very careful study of all the records available to the insurance departments, and I was very much impressed with the fact that the creosote oil and the timber that we deal with really had very little to do with the fires. This paper ought to be spread broadcast not only among creosoters but among the insurance men particularly, and among the public to emphasize the fact that creosoting plants face the same problems that are faced all over the United States; namely, that our materials are not the things that need watching so carefully, but the thing that is the risk is the carelessness which surrounds the use of that material. In other words, if I did not misunderstand Mr. Hubbell, looking after the houses, weeds in the yard, and careless arrangement and things of that sort, are very much more vital factors in insuring a safeguard against fire and consequently lower rates, than the mere fact we use inflammable material in the shape of timber for creosoting.

THE PRESIDENT: Would anybody else like to address us on this subject?

MR. F. J. ANGIER: I would like to ask Mr. Hubbell a question.

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I understood you to say that you recommend calcium chloride as being the best thing to use in barrels of water to prevent freezing. How many pounds should be used in a barrel of water to prevent freezing at, say 20° below zero?

MR. J. G. HUBBELL: To prevent freezing, calcium chloride should be used in the following ratio: 3½ lbs. per gallon for 10° below; 4 lbs. per gallon for 18° below; or 5 lbs. per gallon for 40° below.

It should be added that after the barrels have been tarred or paraffined they should be greased around the top to keep the salts from creeping. The brine does not evaporate. In fact a strong solution in a damp climate would probably increase in bulk slowly through the absorption of moisture, for which calcium chloride has a strong affinity.

THE PRESIDENT: It is well to have brought out the fact that the prevention of fire consists largely in being careful and doing the policing around a wood-preserving plant that should be done in every manufacturing establishment. An appreciation of the fact that creosoting materials are not extremely risky if care is taken will affect the use of creosoted wood where misunderstanding and misconception of the actual state of affairs incline consumers to be prejudiced against it.

Yesterday we heard about the available supply of one material used in wood-preserving operations, and we are fortunate this morning in having Mr. Esau of The Barrett Co., to open a discussion on the available supply of creosote during 1918 (applause).

MR. R. ESAU: Mr. Chairman and Gentlemen, from what I heard outside of the discussion that took place here yesterday on the available tie supply, I thought possibly you might not be interested in what I might have to say about creosote oil supplies. The situation, I am afraid, is pretty much the same. You, of course, are very much interested in trying to peer into the future to see what it has in store for you, and in that respect you are in the same boat with The Barrett Company. We also would like to be able to look ahead and see what there is in store for us in the way of supplies. Unfortunately, I am not able today to give you definite figures. We have not been able as yet to compile our data, and if I had all the figures available probably some of them I would not care to quote. However, the picture will be a gloomy one.

We have contracts for large amounts of coke-oven tar, and we find that the producers of these tars are to a large extent burning them for fuel in steel plants. I understand that the rate at which coke-oven tar is now being burned is about 1,250,000 bbls. per annum. At Gary

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they have a production of about 300,000 to 350,000 bbls. per annum, and during 1917, by insistent pleading, I managed to get about 10,000 bbls. from them. That is about 3% of their production. The tar produced at Joliet, or the equivalent of it, is being consumed also by burning; that is, about 150,000 barrels. The Inland Steel Company's entire production of coke-oven tar is also being burned. That is about 100,000 barrels. There are three plants within Chicago's switching limit where there is practically no tar available. What the situation is at Youngstown, Sharon, Sparrows Point and other plants, I do not know exactly, except that large amounts of tar are being burned, and the latest figures I have from New York show that the consumption of coke-oven tar for fuel is in the neighborhood of 1,250,000 bbls. per annum. That, of course, you can readily see, profoundly affects the ability of the tar distiller to deliver creosote oil.

About 3 or 4 years ago we thought that we would be faced with a tremendous increase in production of coke-oven tar, that it would amount to a flood. We were worried about it. We were wondering how we could develop the business so as to take care of that tremendous amount of material, because in the distilling of coal tar we also had to get rid of pitch. It was not such a big problem to figure out how we could sell the oil, but the big problem was the burning of pitch, which Mr. Childs spoke of before the American Iron and Steel Institute, I believe it was, some years ago.

The insistent demand, however, for spot steel through the war's demands has changed the condition tremendously, so that today instead of having a surplus of material that we do not know what to do with we are facing an acute shortage, and I am of the opinion that the production of creosote oil during 1918 will not be near as much as it was in 1917, and we know that 1917 was not quite as much as it was in 1916.

Speaking for our company, I know that we have been carrying over undelivered on contracts that should have been completed last year a very large amount of oil. A great many of the men here have been writing letters and wiring me, and some calling me on the long-distance phone, and some coming in personally, pleading, threatening, demanding all sorts of things; but you cannot get blood out of a turnip.

The importation of oil is a subject that I am not very familiar with. The domestic situation, as I said before, is nothing but a gloomy picture, and we, realizing that, have been endeavoring in every possible way to make our oil go just as far as we possibly could. That is all I can say. I will be glad to answer questions if you care to ask them (applause).

THE PRESIDENT: Mr. Esau's picture is no more cheerful than

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he announced it would be; but the facts are what we are after. We are again fortunate in having with us Mr. Fulks, who can speak to us from the standpoint of the American Tar Products Company.

MR. E. B. FULKS: Gentlemen, I am of opinion that the least said about a pessimistic subject the better, and my information and the facts at hand only confirm what Mr. Esau said. The situation as to burning tar is among all distillers the same, and as to whether it will get worse or better nobody knows. We all know the fuel conditions.

The most cheerful and optimistic phase you can put on the matter is that conditions for 1918 may perhaps be as good as they were in 1917, with the exception of the fact that we started into 1917 with a surplus of about 12,000,000 or 15,000,000 gals. of imported oil on hand. In other words, the embargo against imported oil went into effect about Christmas of 1916. Two vessels came in after that, and those vessels, with the accumulation at various storage points, amounted to almost 15,000,000 gals., so that in 1917 we used about 15,000,000 gals. in excess of the domestic production.

If the tar burning and so on continues about the same as it did in 1917 the production of oil will be about the same. We have no control over this tar-burning business. If it should cease, of course the production of oil would be quite a bit larger, but there is no reason for expecting that it will cease; in fact, we have fears that it will increase.

THE PRESIDENT: Mr. Fulks' brush is apparently dipped in the same black paint that Mr. Esau's was. He referred to the importations of creosote. I believe Mr. Lembcke is in the audience, and we would like to have a word from him on this subject.

MR. G. A. LEMBCKE: Gentlemen, you can all appreciate that under present conditions it is pretty difficult to get any exact information from the other side. When in January, 1917, the English government put an embargo on creosote oil, importation of foreign oil here of necessity stopped. Great Britain does not permit a gallon of oil to be exported; even the retail business is supervised carefully by the government, and in some instances the treating plants in Great Britain are not allowed any oil, as every bit of it is used for fuel purposes.

We are informed that once the war is stopped there will be available from Great Britain larger quantities of oil for export than ever before. A good many installations have been brought up to maximum efficiency, and figuring on the basis of the present output, we may look for larger quantities.

Of course, whether or not those quantities can be brought over soon after the war remains to be seen, as the tank steamer situation,

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will enter into that question very seriously. Our information is that tankage is building faster than it is being sunk, so we, I believe, will have available at the end of the war more tankage than we had in 1914 when this war began. On the other hand, the rates that will have to be paid right after the close of the war may be prohibitive. The steamers going from here to the other side will earn such enormously high freights that they will not bring creosote back unless we pay very high rates.

As to the German supply of oil I know nothing at present. As long as we had communication with Germany we understood that they were very anxious to resume business relations as soon as they could.

THE PRESIDENT: Every angle of this question has been touched from the producing side. Have the consumers any question to ask, which Mr. Esau very kindly volunteered to answer? Apparently they have taken Mr. Fulks' advice that the less said the better.

As a matter of accommodation to Mr. Teesdale, who cannot be here this afternoon, it has been decided to move the report of the Committee on Wood-Block Flooring and Paving to this morning's session, and we will have it now.

REPORT OF COMMITTEE ON WOOD-BLOCK PAVING.

To the Members of the American Wood-Preservers' Association:

The instructions of the Executive Committee to the Committee on Wood-Block Paving for 1917 were as follows:

To investigate and report on:

(1) The paving of street-car traeks.
(2) The flooring of structures with wood block.
(3) The suitability of western larch as block for flooring and paving.
(4) The treatment of Douglas fir and western larch blocks.
(5) Asphalt filler for wood-block flooring or paving.
(6) The laying of wood blocks on a coating of bituminous paint.

The Committee desires to report progress on Nos. 1, 3, 4, and 5. Considerable work has been done on a specification for asphalt filler, but the Committee is not prepared to present a specification. There is ample evidence that asphalt fillers, if properly applied, give very satisfactory results.

Considerable progress was made on No. 1, but the Committee desires to reserve a report until additional work has been completed.

The report on bituminous paint coat is presented as a specification for information. It is felt that at least one more year of experience

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with this type of construction should be had before definitely adopting it as a standard method.

The Committee desires to emphasize the position taken in 1916 on sand fillers and sand cushions, namely, that the use of sand filler or sand cushion is not recommended; that, in the opinion of the Committee, the use of sand filler is very liable to result in a ruined pavement; and that sand cushion, while less troublesome than sand filler, is a poor method of construction and invites trouble.

Your Committee believes that to prevent expansion trouble a cement mortar cushion or the bituminous paint coat construction should be used, the surface of the pavement being thoroughly sealed against water by a bituminous filler. The prevention of expansion trouble is almost wholly a construction problem and success depends upon keeping water from the base of the blocks.

Your Committee recommends that the Association adopt the specification for interior blocks and the definition for interior wood blocks given in the first paragraph, and that same be printed in the MANUAL.

C. H. TEESDALE, *Chairman.*
WALTER BUEHLER,
F. W. CHERRINGTON,
A. L. KUEHN,
A. H. NOYES,
H. M. NEWTON,
A. STAMFORD.

REPORT OF SUB-COMMITTEE ON INTERIOR WOOD-BLOCK FLOORS.

In submitting a specification for the treatment and laying of interior creosoted wood-block floors your Committee desires to define an interior floor as follows:

An interior wood-block floor is one that is laid in a heated or constantly dry room or roofed enclosure, where the blocks will not be subjected to moisture or to very humid conditions.

Your Committee desires to call attention to the fact that if floors are to be laid in wet or damp environment, or are to be flushed frequently, the blocks should be handled like exterior blocks, as described in the specification* adopted by this Association in January, 1917, treated as follows:

*From Specifications for Creosoted Wood-Block Paving, Proceedings, American Wood-Preservers' Association, 1917, pp. 455, 456.

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"The timber may be either air-seasoned or green, but should preferably be treated within 3 months from the time it is sawed. Green timber and seasoned timber shall not, however, be treated together in the same charge. The blocks shall be treated in an air-tight cylinder with the preservative hereinbefore specified. In all cases, whether thoroughly air-seasoned or green, they shall first be subjected to live steam at a temperature between 220° and 240° F.† for not less than 2 hours, nor more than 4 hours, at the discretion of the treating-plant operator, after which they shall be subjected to a vacuum of not less than 22 ins., held for at least 1 hour. While the vacuum is still on, the preservative oil, heated to a temperature of between 180° and 220° F., shall be run in until the cylinder is completely filled, care being taken that no air is admitted. Pressure shall then be gradually applied not to exceed 50 lbs. at the end of the first hour nor 100 lbs. at the end of the second hour, and then maintained at not less than 100 lbs. nor more than 150 lbs. until the wood has absorbed the required amount of oil.‡

"After this a supplemental vacuum shall be applied in which the maximum intensity reached shall be at least 20 ins., and shall continue for a total period of not less than 30 minutes. If desired, this vacuum may be followed by a short steaming period."

Your Committee desires to call attention to the order in which the two types of construction (bituminous paint coat and mortar bed) appear in this specification, and wishes to state that it is not the Committee's intention that one method should have precedence over the other. The type of construction to be specified must be decided by the engineer designing the floor in each particular case.

Your Committee desires to call especial attention to the necessity of keeping blocks dry that are to be stored for any length of time before laying.

Your Committee desires to state that while the specification provides for concrete base only, it is entirely practical to lay blocks on plank sub-base. For this construction the planks must be creosoted and sufficiently supported to form a rigid foundation under the blocks. Two courses of felt (tarred building paper) well pitched on both sides must be used between the planks and the blocks. The bituminous paint coat method of construction can be followed if plank sub-base is used.

Your Committee desires to call attention to the practicability of using the bituminous paint coat method of construction and employing a shallower block. Where traffic on floor is not too heavy your Committee believes a 2½-inch block will give satisfactory results.

WALTER BUEHLER, *Chairman.*
F. W. CHERRINGTON.

SPECIFICATION FOR INTERIOR WOOD-BLOCK FLOORS.

Timber.

KIND.—*The wood from which the blocks are to be manufactured*

†In no case shall a steam pressure of 20 lbs. per square inch be exceeded.

‡This treatment is recommended for yellow pine only. It is probably also suited to Norway pine, hemlock, black gum and tamarack, but not to Douglas fir. Further recommendations on the treatment of these species are reserved for the future.

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shall be air-dry southern yellow pine, Douglas fir, tamarack, Norway pine, hemlock, or black gum. The blocks must be sound and well manufactured, square butted, square edged, free from unsound, loose or hollow knots, knot holes, and other defects, such as shakes, checks, etc., that would be detrimental to the blocks.

In southern yellow pine or Douglas fir the number of annual rings in the 1 inch which begins 2 inches from the pith of the block shall not be less than six, measured radially, provided, however, that blocks containing between five and six rings in this inch shall be accepted if they contain 33⅓% or more summerwood. In case the block does not contain the pith, the 1 inch to be used shall begin 1 inch away from the ring which is nearest to the heart of the block. The blocks in each charge shall contain an average of at least 70% heartwood. No one block shall be accepted that contains less than 50% of heartwood.

Size of Blocks.

Blocks shall be 5 to 8 inches long, they shall be 3 inches in depth (parallel to fiber), they may be from 2¾ to 4 inches in width, but on any one floor all of them should be of uniform width. A variation of ⅛ inch shall be allowed in the depth, and ⅛ inch in the width of the blocks from that specified.

Preservatives.

The preservatives used are to be those specified on page 308, 1917 PROCEEDINGS *of the American Wood-Preservers' Association.*

Treatment.

Blocks shall be treated in air-tight cylinders in accordance with any standard empty cell process, leaving in the blocks at the end of the treatment not less than 5 lbs. nor more than 8 lbs. of water-free creosote oil per cubic foot of wood.

The blocks after treatment shall show satisfactory penetration of the preservative, and in all cases the oil must be diffused throughout the sapwood. To determine this at least 25 blocks shall be selected from various parts of each charge and sawn in half at right angles to the fibers through the center, and if more than one of these blocks show untreated sapwood the charge shall be re-treated. After re-treating, the charge shall be again subjected to a similar inspection.

The surface of the blocks after treatment shall be free from deposits of objectionable substances, and all blocks that have been materially warped, checked or otherwise injured in the process of treatment shall be rejected.

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Handling Blocks After Treatment.

The blocks shall be shipped in a closed car and protected from the weather at all times before being laid. It is important to have the wood as dry as possible at the time the floor is constructed.

Inspection.

All material herein specified and processes used in the manufacture of blocks therefrom shall be subjected to inspection, acceptance, or rejection at the plant of the manufacturer, which shall be equipped with all the necessary gauges, appliances, and facilities to enable the inspector to satisfy himself that the requirements of the specification are fulfilled. The purchaser shall have the further right to inspect the blocks upon delivery for the purpose of rejecting any blocks that do not meet these specifications, except that the plant inspection shall be final with respect to the kind of wood, rings per inch, oil, and treatment.

Sub-Grade.

The sub-grade shall be thoroughly rolled, tamped, or otherwise prepared to prevent yielding after the concrete base and wood-block floor are placed.

A. Pitch Paint Coat Construction.

CONCRETE BASE.—*On the sub-grade properly prepared shall be spread the concrete base of the thickness specified.*

The concrete shall consist of one part cement, three parts fine aggregate, and five parts coarse aggregate, mixed with sufficient water to produce a wet mixture that can be readily floated. The surface of the concrete shall be struck off, with an iron-shod straight edge, and the top floated to a smooth surface.

The surface of the finished concrete when tested, by laying a metal-shod straight edge at least 5 feet long on surface in any direction, shall show no variation greater than ¼ inch, projections greater than ¼ inch to be trimmed. Depressions to be flushed with mortar consisting of one part cement to three parts sand of sufficient thickness to bring surface to within the allowable limits specified.

CEMENT.—*Cement shall be Portland cement conforming to the specifications of the American Society for Testing Materials.*

FINE AGGREGATE.—*Fine aggregate shall be clean, sharp sand.*

COARSE AGGREGATE.—*Coarse aggregate shall consist of clean, hard, tough, durable crushed rock or gravel, graded in size, free from vegetable or other deleterious matter. The size of the coarse aggregate shall be such as to pass a 1½ inch round opening, and shall range from 1½*

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*inches down, not more than 5% passing a screen having 4 meshes per linear inch, and no intermediate sizes shall be removed.**

PITCH PAINT COAT.—*On the thoroughly cleaned and dried concrete base shall be spread a uniform paint coat of pitch. The pitch shall be a coal-tar pitch as specified under "Filler," except that the melting point shall be not less than 135° F., nor more than 145° F. It shall be heated to a temperature of not less than 250° F., and not more than 300° F., poured directly on concrete, and spread smoothly while hot to a uniform thickness of not more than ⅛ inch.*

B. Dry-Mortar Bed Construction.

CONCRETE BASE.—*On the sub-grade properly prepared shall be spread the concrete base, made in accordance with the specification of the purchaser. At no one place shall the surface of the finished concrete vary more than ½ inch from the given grade.*

MORTAR CUSHION.—*Upon the concrete foundation shall be spread a layer of thoroughly mixed mortar made of one part of Portland cement of the character provided for in the foundation, and four parts of sand. Only sufficient water shall be added to this mixture to insure a proper setting of the cement, the intention being to produce a granular mixture which may be raked to the desired grade. The mortar shall be spread in place on the foundation immediately in advance of the laying of the blocks. The mortar bed shall be raked to the approximate grade and struck by templates to a surface parallel to the grade and contour of the finished floor. The finished mortar bed shall have an average thickness of not over ¾ inch, and shall in no case be over 1 inch in thickness.*

Laying Blocks.

On either the hardened pitch paint coat or dry-mortar bed the blocks shall be carefully set with the fiber of the wood vertical, in straight parallel courses.

The blocks shall be laid as tightly together as possible by ramming both in the direction of the course and at right angles to it. Nothing but whole blocks shall be used, except in starting a course, or such other cases as the purchaser may direct, and in no case shall the lap joint be less than 1 inch. The joints between blocks may be filled with a bituminous filler.

The filler should be heated to a temperature of not less than 250° F., nor more than 300° F., and poured directly on the surface of the

*Where blocks are to be laid on concrete base already prepared which is too rough to lay blocks directly thereon, the surface of the concrete shall be thoroughly washed, and a mortar bed of sufficient thickness to even up surface shall be spread thereon and finished to a smooth, even surface. Mortar shall consist of one part cement and three parts sand, and shall be mixed with sufficient water to allow same to be readily finished.

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*blocks, then squeegeed by means of a hard rubber squeegee into the joints between the blocks. Care must be exercised that no surplus pitch be left on the surface of the blocks or splashed on the walls, columns, or machine foundations.**

EXPANSION JOINTS.—*Expansion joints 1 inch wide shall be provided for around all walls, columns or machine foundations. Expansion joints shall be filled with coal-tar pitch of the same quality as that used for filling joints between blocks.*

Filler.

Either coal-tar pitch or asphalt fillers may be used for the dry-mortar bed construction. Only coal-tar pitch fillers may be used in the pitch paint coat construction. Coal-tar pitch fillers must conform to the specifications printed in the 1917 PROCEEDINGS *of the American Wood-Preservers' Association, page* 458, *except that the melting point shall be between* 135° *and* 145° *F.*†

REPORT OF SUB-COMMITTEE ON BITUMINOUS-PAINT COAT CONSTRUCTION.

Your Committee, in its report submitted January, 1917, called attention to the sentiment at that time crystallizing among engineers and manufacturers in favor of an absolutely watertight type of pavement construction. The demonstrated failures of sand cushions and sand fillers emphasized the necessity for a more stable form of construction.

Your Committee simply called attention to a new method of construction, which consisted of coating the smoothly finished concrete base with bituminous cement and allowing this to get cold and hardened before attempting to set the block on it. In the past year this form of construction has been in a large measure standardized. A considerable yardage has been laid, the success of which will no doubt result in its increased popularity.

A. H. NOYES, *Chairman.*
WALTER BUEHLER.

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*Blocks filled with coal-tar pitch as above described will be covered with a very fine film of pitch which will readily wear off. If, however, this is objectionable, and it is desired to fill the joints with pitch, the following is recommended: After blocks are laid the surface shall be thoroughly cleaned and then mopped with a commercial creosote oil. This mop coat of oil shall be immediately followed by pitch filler squeegeed into the joints as above described. To be successful the creosote mop treatment must be done just before the filler is applied. As soon as the pitch has hardened, iron scrapers, such as are used in cleaning snow and ice off the sidewalks, can be used to scrape off the surplus pitch. The paint coat of creosote oil will cause the pitch to peel off easily, leaving the floor in a perfectly clean condition.

†Specifications for asphalt fillers have not as yet been prepared by the Association.

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SPECIFICATIONS FOR PITCH PAINT COAT METHOD OF CONSTRUCTION FOR STREET PAVEMENT WORK.†

(Presented as Information)

Base.

On the sub-grade, properly prepared, shall be spread the concrete base of the thickness specified. The concrete shall consist of one part cement, three parts fine aggregate, and five parts coarse aggregate, mixed with sufficient water to produce a wet mixture that can be readily floated. A long-handled wood float with upturned ends to prevent ridging shall be used to finish the surface in one operation. The surface of finished concrete when tested, by laying a metal-shod straight edge at least 5 feet long on surface in direction parallel to curb-line, shall show no variation greater than ¼ inch, projections greater than ¼ inch to be trimmed. Depressions to be flushed with mortar, consisting of one part cement to three parts sand of sufficient thickness to bring surface within the allowable limits specified.

CEMENT.—Cement shall be Portland cement conforming to the specifications of the American Society for Testing Materials.

FINE AGGREGATE.—Fine aggregate shall be clean, sharp sand.

COARSE AGGREGATE.—Coarse aggregate shall consist of clean, sharp, tough, durable crushed rock or gravel, graded in size, free from vegetable or other deleterious matter. The size of the coarse aggregate shall be such as to pass a 1½ inch round opening and shall range from 1½ inches down, not more than 5% passing a screen having 4 meshes per linear inch and no intermediate sizes shall be removed.

Pitch Paint Coat.

On the thoroughly cleaned and dried concrete base shall be spread a uniform coat of pitch as hereinafter specified. It shall be heated to a temperature of not less than 250° F., and not more than 300° F., poured directly on concrete and spread smoothly while hot to a uniform thickness of not more than ⅛ inch.

Laying Blocks.

On the hardened pitch paint coat, thus prepared, the blocks shall be carefully set with the fiber of the wood vertical in straight parallel courses, leaving a space next to the curb 1 inch in width for the expansion joint.

†Where this specification is used it should be inserted in the specifications printed in the 1917 PROCEEDINGS of the American Wood-Preservers' Association, page 456, at Section 7.

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The blocks shall be laid by setting them handtight. No joint shall be more than $\frac{1}{8}$ inch in width. They may be driven together every tenth course to keep the rows straight. Nothing but whole blocks shall be used, excepting in starting a course, or in such other cases as the purchaser may desire, and in no case shall the lap joint be less than 2 inches. Closures shall be carefully cut and trimmed by experienced men. The angle of the course to the curb shall be fixed at the discretion of the purchaser. After blocks have been placed they shall be rolled by a tandem roller, weighing between 4 and 7 tons.

Expansion Joints.

Expansion joints 1 inch wide shall be provided next to and along the curb-line, expansion joints being filled with pitch as hereinafter specified.

Filler.

After rolling is completed the joints between the blocks shall be filled with a pitch filler as hereinafter specified. This shall preferably be done only when the temperature of the air is above 45° F.

The pitch shall be heated to a temperature of not less than 250° F., nor more than 300° F., poured directly on the surface of the blocks, and by means of a hard rubber squeegee shall be squeegeed into the joints between the blocks. Care must be exercised that no surplus pitch is left on the surface of the blocks, and in no case shall there be a second application of pitch. After the filler has been thoroughly worked into the joints between the blocks the surface shall be completely covered to a depth of about $\frac{1}{3}$ inch, with clean, coarse, dry sand, which shall be left upon the pavement.

Coal-Tar Pitch.

The pitch used for the paint coat, expansion joints and filler, shall be obtained entirely from the distillation of coal tar and shall comply with the requirements specified on page 457, 1917 PROCEEDINGS of the American Wood-Preservers' Association.

MR. C. H. TEESDALE: I would like to move, Mr. President, that the specification for interior wood-block floors be adopted by the Association and inserted in the MANUAL, and furthermore, that the definition for interior wood block also be adopted and inserted in the MANUAL.

MR. J. H. WATERMAN: Mr. President, I want to ask a question. Can the Committee tell us what the Chicago specifications are, that is, the amount of oil per cubic foot?

MR. C. H. TEESDALE: The Chicago specifications for what?

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MR. J. H. WATERMAN: For wood blocks. You said 5 to 8 pounds. What are the Chicago specifications?

MR. C. H. TEESDALE: I never heard that they had a specification for interior wood block.

MR. C. M. TAYLOR: Mr. Chairman, what is meant by an air-tight cylinder?

MR. C. H. TEESDALE: Why, a cylinder such as the Central Railroad of New Jersey has at the Port Reading plant (laughter).

MR. C. M. TAYLOR: That is oil tight, too. The words air tight seem to me to be not quite right there.

MR. WALTER BUEHLER: I think that is probably a term that has been handed down by custom.

MR. C. M. TAYLOR: From the looks of your specification there should be consideration as to the size.

MR. A. E. LARKIN: I would like to know if the Committee desires to restrict the specification to the use of the empty-cell process. The specification provides for any standard empty-cell treatment. Is it to be understood that the Committee does not care to take into consideration the full-cell process?

MR. C. H. TEESDALE: I doubt whether the specification could be fulfilled with the full-cell process without exceeding the 8-lb. absorption.

MR. A. E. LARKIN: Is it necessary to confine yourself to an 8-lb. absorption? Is it not quite possible that in certain cases the heavier treatment would be required and altogether desirable?

MR. C. H. TEESDALE: Well, I think the Committee felt that where heavier treatments were necessary the specification which is mentioned in the introduction should be used, and that the specification for interior block as defined by the Committee, would not require over an 8-lb. absorption. Where a heavier absorption is required the other specification would apply.

MR. A. E. LARKIN: That is taking quite a lot for granted. There are a great many wood-block floors throughout the country, and there are a great many services to which wood block would be subjected where a much heavier treatment and a full-cell process might be required. There is no question but that for ordinary floors the empty-cell process and a light treatment are satisfactory. This treatment would tend to reduce the cost of the floor and still get the very best distribution of oil for the quantity used. So far, so good; but it seems to me the Committee should take into consideration the fact that in many

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cases even in interior work, a heavier full-cell treatment would be required.

MR. C. H. TEESDALE: That is quite true, but the Committee tried to take care of that point in the introduction where we say:

> Your Committee desires to call attention to the fact that if floors are to be laid in wet or damp environment or are to be flushed frequently the blocks should be handled like exterior blocks, as described in the specification adapted by this Association in January, 1917.

Then we discussed the treatment which we specified last year.

MR. J. H. WATERMAN: Let me ask my question another way. Did you have any specification before you when you worked these out, and how much oil did they show per cubic foot for interior work? The Committee must have gone into this carefully. It knows whether there are other specifications, and how much oil has been used. What has been the standard practice prior to this?

MR. C. H. TEESDALE: The standard practice has varied greatly. We have records on some three or four hundred floors which were laid.

MR. J. H. WATERMAN: What was the minimum and the maximum oil?

MR. C. H. TEESDALE: They varied from about 4 lbs. to about 20 lbs.; 8 lbs. is about the average.

MR. J. H. WATERMAN: Has the Committee any information as to which floor gave the best service?

MR. C. H. TEESDALE: Yes.

MR. J. H. WATERMAN: Which gives the best service?

MR. C. H. TEESDALE: It was not a question of the amount of oil. It was a question of the construction of the floors which failed because of construction troubles, largely because of the use of a sand filler and a sand cushion.

MR. J. H. WATERMAN: The Committee would not say that the amount of oil was immaterial as to the life of the floor, would they?

MR. C. H. TEESDALE: The Committee would not take that position at all, but there were no floors which had been in existence for a sufficient length of time to have the oil have any effect on their condition. The condition of the floors was determined entirely by their construction and not by the amount of oil that was in them at the time. Wood-block flooring has not been used for a sufficient time to have very much of it in a decayed condition.

THE PRESIDENT: Gentlemen, you have heard the recommendations of the Committee. It asks that the Association approve at this meeting, for adoption by letter ballot later and inclusion in

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the MANUAL, the italicized paragraphs. Do I hear a second to that?

DR. HERMANN von SCHRENK: I second the motion.

MR. J. H. WATERMAN: I would like to ask the Committee what kind of floors would you recommend wood blocks for freight houses or what buildings?

MR. C. H. TEESDALE: The Committee has not discussed that question.

MR. J. H. WATERMAN: But it is a good thing to discuss.

MR. C. H. TEESDALE: We were not instructed to report on that.

MR. J. H. WATERMAN: Can you give us any information as to where wood-block pavements are used in interior work?

MR. C. H. TEESDALE: You can find in the report that I made two years ago before this Association a list of some 39 types of interior locations where wood block is used.

MR. J. A. JOHNSON: Mr. President, not having used any oil for treatment of any kind, although it has been used quite a lot on paving blocks, I would like to ask a question as to the difference between the empty-cell process and the full-cell process. I have an idea what the theory of that is, but in actual practice it seems to be no more or less than just more or less oil injected into the wood. Is not that the idea?

By the empty-cell process you force in a certain amount, and then try to draw it off. By the full-cell process you put in so much or all that it will stand, depending on what the amount is you want to inject, and just leave it there. What is the object then of the empty-cell treatment? Is it from the financial end or from the saving of oil? If so, if that is sufficient, if you can get the inside cell coated with oil, what would be the object of using the full-cell treatment then?

MR. C. H. TEESDALE: It would be possible to treat the blocks with 5 or 8 lbs. of oil by the full-cell process, but the distribution of oil in the blocks would be very unsatisfactory and the specification would not be fulfilled, particularly at the points which require complete sapwood penetration. That could only be obtained by a 5 to 8-lb. treatment by the empty-cell process.

MR. J. A. JOHNSON: We seem to have had considerable trouble with the expansion of wood blocks used in roundhouses. In one place the engineer claimed that it even moved the wall out some soon after the blocks had been laid. That undoubtedly was due to some fault in construction.

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THE PRESIDENT: Any further discussion?

MR. A. E. LARKIN: Mr. President, is the Committee in position to make any recommendation at all for wood blocks where they are used under conditions that require flushing with water? Of course, the members here would read the PROCEEDINGS more carefully than the layman. They might catch that paragraph which you referred me to a minute ago. It did not get to me in reading along with you, and I am quite sure that if a man was looking for a specification to cover a special condition where the question of expansion and contraction was emphasized, because of the floor being flushed with water, he would make a mistake in attempting to follow the recommendation of this Committee.

Before this specification is adopted, would it not be wise to consider adding something that would help a prospective user who would need full-cell work?

MR. J. H. WATERMAN: Why not include those two paragraphs on page 96?

MR. C. H. TEESDALE: Mr. Buehler would like to make a few remarks. He is chairman of the sub-committee that prepared this report.

MR. WALTER BUEHLER: If you will note the sub-committee in getting up this specification was very careful in first defining an interior block. It is very important when you have this specification under consideration to consider it in connection with this definition. The Committee states that:

> An interior wood-block floor is one that is laid in a heated or constantly dry room or roofed enclosure, where the blocks will not be subjected to moisture or to very humid conditions.

This definition must be considered with the specification. I see no objection to adding the paragraph calling attention to treatment where floors would be flushed as a footnote to the specification under treatment.

MR. J. H. WATERMAN: If the Committee would include that as a footnote I would be very glad to second the motion.

MR. C. H. TEESDALE: It is suggested then that it be placed as a footnote with the asterisk after the title, "Specification for Interior Wood-Block Floors." The definition would also be placed in the MANUAL as footnote No. 1 after the word "Interior" in the title, "Specification for Interior Wood-Block Floors," and the following statement would appear as footnote No. 2 after the word "Floors" in the title, "Specification for Interior Wood-Block Floors," and would read as follows:

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If floors are to be laid in wet or damp environment, or are to be flushed frequently, the blocks should be handled like exterior blocks as described in the specification adopted by this Association in January, 1917.

THE PRESIDENT: Dr. von Schrenk, do you accept that suggestion?

DR. HERMANN von SCHRENK: Yes.

THE PRESIDENT: Does everybody understand that the paragraph on page 96 will be put as a footnote to define the word "interior" and also that a qualification of "interior wood-block floors" will be provided by a second footnote from page 96, as follows:

If floors are to be laid in wet or damp environment, or are to be flushed frequently, the blocks should be handled like exterior blocks, as described in the specification adopted by this Association in January, 1917.

Are you ready for the question? All those in favor say "aye", contrary "no"; the "ayes" have it.

MR. C. H. TEESDALE: It was felt that it would be better simply to present the specification this year as information, because this type of construction is more or less new and it was desired to have more data available upon the results being obtained with it. It is the hope of the Committee, however, that this specification can be presented next year for adoption by the Association. Mr. Buehler, have you anything to say on this, or Mr. Noyes?

MR. WALTER BUEHLER: I might state there has been a considerable yardage of this form of construction laid this past summer in Detroit and in Toledo. There was a small yardage laid in St. Louis and one or two other points. The prejudice to overcome is the prejudice against the increased cost, or what is believed to be the increased cost of getting the concrete smooth enough for this form of construction.

It has been found that by preparing a proper specification for the concrete that it is possible to finish the concrete the same as you would finish a one-course concrete pavement by means of long-handled floats and get a sufficiently smooth surface. When we speak of a sufficiently smooth surface we mean an even surface rather than a smooth surface. It is not important to have a sidewalk finish, but the surface must be even. This can be very easily obtained by means of a long-handled float, and the cost of doing the work in this way actually results in a saving as compared with the dry-mortar-bed construction.

THE PRESIDENT: Gentlemen, this specification for pitch paint coat method of construction for street pavement work has been presented as information, and I am sure the Committee would appreciate hearing from anybody who will write to them in regard to it.

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Twelve o'clock is here before we have gotten to the report of the Service Tests Committee. No doubt the most advisable thing to do is to postpone that report until this afternoon.

The announcement from the Chair yesterday said we would vote on the 1919 meeting place before noon today; but the program that was passed out says 2 o'clock this afternoon.

MR. J. H. WATERMAN: Let us vote on it now.

THE PRESIDENT: Has anybody any idea that 2 o'clock would be a better time than the present?

MR. S. R. CHURCH: There is no time like the present.

THE PRESIDENT: The Secretary will please acquaint us with the invitations received.

THE SECRETARY: This Association has been invited to hold its next meeting at San Francisco (laughter), also at Cincinnati, St. Louis, New York and Detroit.

THE PRESIDENT: Gentlemen, you have been made acquainted with the cities which desire our Meeting. Undoubtedly there are some here who have claims for cities they wish to present in person.

DR. HERMANN von SCHRENK: You do not have to say anything about St. Louis. Everybody in this place knows where we are. I have in my grip here a very formidable bunch of invitations extended by the Publicity Committee of St. Louis. I have a letter here from the Mayor, the Chamber of Commerce and the various hotel people, all of whom very strongly urge the consideration of St. Louis as the next convention place. You have not forgotten that this organization was born in St. Louis, and you have not been there since. We have at the present time unequalled hotel facilities, a brand new Statler hotel just opened. I believe we have some small treating plants. We have not as many snowstorms around there as we have here in Chicago, and I need not say that those who come to St. Louis will have a warm reception (applause).

THE PRESIDENT: We have had St. Louis placed in nomination. Does anybody second Dr. von Schrenk's motion?

MR. P. R. WALSH: I second it.

MR. WALTER BUEHLER: Mr. President, I think annually I get up and ask that the convention be held in Chicago. I believe that Chicago is really the logical point for this convention. If you go back through the history of the Association you will find that we have always had successful meetings in Chicago. It is centrally located, and the men seem to come here. Now, St. Louis would be centrally

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located, but we have the Chicago habit, and I think it is a good thing to continue it.

MR. E. E. PERSHALL: I would like to call your attention to the fact that we of St. Louis feel there is a very direct connection between our location and the wood-preserving industry. As a matter of fact within the radius of a very few miles you have all the raw materials to make the finished product—ties, timbers, coke ovens, tar-distilling plants, wood-preserving plants, zinc-chloride plants, and everything entering into this industry seem to be very centrally located around St. Louis.

The matter of choosing between the availability of St. Louis and Chicago for the general personnel of our organization is a consideration with which you are all acquainted, but St. Louis really can give us a very personal touch, a very close material touch and physical connection with every phase of our business. There is a zinc-chloride plant, a coke-oven plant, four tar-distilling plants, and two wood-preserving plants right across the river. St. Louis is the headquarters of the Missouri tie men, and a number of the Ohio tie-producing companies have their offices there. Lumber companies are there in abundance. The fact of the matter is you can go down to St. Louis and place your order for ties, paving blocks or timbers, buy the preservatives, either zinc chloride or creosote oil or a mixture of the two, and have them treated, being in close personal touch with each producer, and never step out of town.

THE PRESIDENT: You have heard St. Louis and Chicago nominated. The good points of each have been stressed by those who believe in them as convention cities. We will have a rising vote and the Secretary will count heads. I will ask for St. Louis first since it was presented first. All those in favor of St. Louis please stand (26 stood up). All those in favor of Chicago please rise (26 stood up).

MR. P. R. WALSH: If you bring the convention to St. Louis, I think people who are interested in the manufacture of ties, can arrange an automobile trip to take the members of this Association out to the timber to see the women hack ties.

THE PRESIDENT: The Secretary is not certain of the vote because he counted some persons standing near the door who now appear to be non-members. We will vote again. Those in favor of St. Louis will please rise (31 stood up). Those in favor of Chicago please rise (24 stood) (applause).

MR. J. H. WATERMAN: Mr. President, I move you that it is the unanimous choice of this convention that we meet in St. Louis

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next year, and if we do not have a good time we will lay it to Dr. von Schrenk.

MR. F. J. ANGIER: I second the motion.

THE PRESIDENT: Gentlemen, it has been moved and seconded that the choice of St. Louis for the 1919 Annual Meeting of the American Wood-Preservers' Association be made unanimous. All those in favor say "aye," contrary "no." St. Louis will be it next year.

MR. M. K. TRUMBULL: Might it not be well to include among the qualifications of St. Louis the fact that there is such an eminent timber and creosoting expert in St. Louis, and that ties may be inspected there as well as produced?

MR. E. E. PERSHALL: That really is no small consideration for even those of us who are down there. It is indeed a pleasure just to go over to Dr. von Schrenk's office, not only for the commercial information which so often prompts a visit, but on account of the fact that Drs. von Schrenk and Kammerer have any amount of data at their laboratories in which they do not anticipate we are even interested, but in which we are intensely interested when they are brought to our attention. Possibly many of you have not seen Dr. von Schrenk's personal contribution to the Missouri Botanical Gardens Museum, which has any number of interesting specimens of treated ties and woods of different character, besides, the Missouri Botanical Gardens are distinctive for their own qualifications. There are all different kinds of wood there, and I thank Mr. Trumbull sincerely and earnestly for calling this to our attention, because that is an advantage which we fellows in the industry at St. Louis enjoy. We further enjoy the privilege of going over just to visit Drs. von Schrenk and Kammerer as an entirely personal matter, entirely aside from business (applause).

THE PRESIDENT: I am sure the Association figures as one of the things it will be sure to do in St. Louis is to see the laboratory of Messrs. von Schrenk and Kammerer and to learn some of the details of what they are doing.

MR. M. K. TRUMBULL: Mr. President, I might add just one thing in this connection, that it may be fitting to have some sort of a special meeting at the 20th anniversary of the formation of this society. It might be suggested to the St. Louis people that St. Louis is the logical point for such a meeting. St. Louis will be afforded an opportunity next January to demonstrate whether she can attract our Association for this occasion six years hence.

THE PRESIDENT: At our Fifteenth Annual Meeting we will very likely be made so anxious to come back, that we will consider

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St. Louis for our twentieth gathering. We will now adjourn until 2 o'clock P. M.

An adjournment was then taken until 2 o'clock P. M.

WEDNESDAY AFTERNOON SESSION.

January 23.

The meeting was called to order by President Foley at 2:30 P. M.

THE PRESIDENT: We will have the report of the Committee on Service Tests, Mr. P. R. Hicks, Chairman.

REPORT OF COMMITTEE ON SERVICE TESTS.

To the Members of the American Wood-Preservers' Association:

Our efforts were concentrated as far as possible toward obtaining authentic service-test records on ties, in the electric as well as the steam railroads, wood-block paving and flooring, bridge and wharf timbers, piling, poles, and posts. A number of new service-test records on ties were sent in, but very little data on electric railway ties were obtained.

A systematic collection and compilation of data of this character has been undertaken by the Forest Products Laboratory in cooperation with your Committee and also in cooperation with the Committee on Wood Preservation of the American Railway Engineering Association.

Papers regarding why treated wood fails, ultimate causes of decay of treated poles, causes of failure in treated wood-block pavement, causes of failure in treated ties, flooring, and piling were to be prepared for the Committee for discussion at this meeting. Since the beginning of the war, however, and especially during the last few months, so many members of the Committee and others who were to prepare these papers have been working upon urgent National Defense problems or have actually entered the Army, that the following papers only were received by the Committee:

The Ultimate Causes of Decay of Treated Poles, by Roger F. Hosford.

Causes and Prevention of Failure of Wood-Block Factory Floors, by L. T. Ericson.

Condition of Treated Wood-Block Pavement in Some Cities in Alabama, Louisiana, and Texas, by C. H. Teesdale.

The Relation Between Average Life of Ties and Percentage Renewals, by Mabel E. Thorne.

RECOMMENDATIONS.

We have no recommendations to offer other than those made by the Committee in January, 1917. While we have not been successful

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this year in obtaining personal reports on pavements, yet we feel very strong that this is the only way in which we can obtain information that can be entirely relied upon.

We find that a great deal of the information received from city officials is incorrect and, therefore, very misleading. Engineers who are not specialists in wood-block paving know nothing about the blocks that have been furnished them, excepting that they are supposed to comply with their specifications, and we know of numerous instances where the specifications were not at all lived up to. This also applies to the construction end of the pavement, and many small details which would have meant the success of the pavements have been omitted or slighted.

We do not anticipate that future committees on service tests will make any great progress in securing valuable reports on numbers of pavements, but we believe that they can pick up reliable reports on individual pavements which, if recorded, will in time produce a collection of valuable reports which will be most instructive.

It is the belief of the Committee that the annual compilation of the durability records on the systematic basis which has been established should be continued and an effort should be made to include as many forms of treated and untreated timber as conditions will permit.

COMMITTEE ON SERVICE TESTS.

P. R. Hicks, *Chairman*,

Ties and Timber.	*Flooring and Paving.*
E. H. Bowser, *Chairman.*	A. W. Dow, *Chairman.*
C. F. Ford	F. D. Beal
W. H. Fulweiler	E. R. Dutton
F. D. Mattos	L. T. Ericson
H. M. Rollins	R. S. Manley
H. von Schrenk	J. C. Williams

REPORT OF SUB-COMMITTEE ON SERVICE TESTS OF TIES AND TIMBER.

The instructions issued to the Sub-Committee on Service Tests of Ties and Timber were as follows:

To investigate and report on:

(1) The use of treated wood.

(2) The reason for unsatisfactory results in the use of treated wood.

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Circulars were sent to the various railroads and others with a request for service-test data on ties, piling, and bridge and wharf timber. The returns were classified and tabulated on cards in such form that they are easily accessible. As the records of this character are still coming in, and as the Executive Committee has decided that the service-test records would not be printed this year, no attempt has been made to discuss the data collected. Practically all of the records of tie renewals appearing in the 1917 PROCEEDINGS were brought up to date and many new records added.

The service-test data received on piling,bridge and wharf timber, poles, and posts are far from satisfactory, although some good records were obtained.

Acknowledgment is made to the various railway officials and others who furnished the records.

The following summary by Mr. J. H. Waterman brings up to date the Chicago, Burlington & Quincy R. R. data in the 1917 PROCEEDINGS (pages 88 and 89):

PROCESS	Number of ties placed.	Number of ties removed to Jan., 1918	Per cent. removed to January 1918.	
			Decay.	Other causes.
Straight Creosote.	3,264	64	0.3	1.6
Card	15,817	730	0.6	3.9
Burnett	2,488	162	2.7	3.8
Untreated	3,270	2,740	82.2	3.4

REPORT OF SUB-COMMITTEE ON SERVICE TESTS OF WOOD-BLOCK FLOORING AND PAVING.

The instructions for the work of this year's Sub-Committee, contained in the report made January, 1917, is as follows:

(1) Fill out the missing information on streets reported in the 1917 report.

(2) Keep record from year to year of the behavior of streets that have been reported upon, especially examine more closely into the streets which have failed, and endeavor to find out what has been the actual cause of the failure.

(3) Collect data on streets paved with tamarack, Norway pine, and black gum.

(4) Collect data on wood-block flooring.

In 1916 circular letters were sent to all cities in the country having

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wood-block paving, asking for the fullest information on them. Where the cities did not reply before a certain date, personal appeals were made. As this was done in the latter part of the year we felt that it would be useless to apply to the city officials at this time. We, therefore, endeavored to obtain personal reports on individual pavements and upon pavements laid with woods other than yellow pine, We have met with poor success in obtaining any reports on individual pavements. This, however, is not surprising as it is a difficult matter for a man, unless he is thoroughly acquainted not only with the subject of wood-block paving, but with the actual construction of the pavement which he is inspecting, to give any information of value on it.

We have received a report on pavements laid with western larch or tamarack by Mr. S. B. Lindley of Spokane, Wash., through the kindness of the Forest Products Laboratory, which will be found below.

ULTIMATE CAUSES OF DECAY OF TREATED POLES.

By Roger F. Hosford.

In considering the causes of decay of treated poles, it is first necessary to recognize that several forms of treatment are employed and that these differ widely with respect to the depth to which the pole timber is penetrated and the area on the pole surface which it is desired to protect by treatment. A great majority of the poles which have been used and are being used today are cut from species of timber relatively very durable when in contact with the soil. The upper parts of poles cut from these durable timbers undergo much less change, on the average, than the part in contact with the soil, so that treatment is applied even to these durable species with the aim of increasing the life of the pole.

The simplest treatment consists in applying preservative only to those parts of the pole which will be from 1 foot to 2 feet below to 1 foot to 2 feet above the surface of the soil. Such treatment will protect that part of the pole which, in the average setting, is subject to the greatest rate of decay. So highly localized a treatment will usually be characterized by comparatively slight penetration of the preservative. The ultimate cause of the decay of brush-treated poles, the most widely used of this class of treatments, has been definitely determined to be the mechanical breakdown of the treated layer, either through checking of the timber or cutting by tools, etc. The thin-treated layer will be found unchanged when decay has begun, but beneath it at some

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point where an interruption to its continuity exposed untreated wood, the attacks of fungi or of insects will be found to have started the process which ultimately brings about the destruction of the pole.

There are other treatments for the durable timbers in which the preservative penetrates a greater depth from the surface, such as the process first styled "the open tank," but now often termed "the hot and cold bath." In this process the entire butt of the pole receives treatment up to a level which will be 1 foot to 2 feet above the surface of the soil when the pole is set. Very few cases where decay has set in on these butt-treated poles have yet been observed, although at least one lot of poles has been under observation for over 11 years. Here again such decay as has been observed occurs around checks or scars which have exposed the underlying untreated wood. The number of poles showing decay is, however, less than 3% of the number under observation, so that the experience to date cannot be said to afford indications as to what the principal cause of failure will be.

Some use is made of pole timbers which, without treatment, are durable neither in the soil nor above it. The best-known case in this class is the use of pine in the south, and the employment of southern pine poles fully creosoted by cylinder pressure processes has been increasing substantially in recent years. Here again the principal conditions leading to the initiation of decay are openings which expose the untreated interior part of the pole. In the observed cases checks and shakes are the predominant causes for the opening in the treated layer, but any condition which exposes the untreated core, whether an initial timber defect, a timber defect brought about by service conditions, or a mechanical injury, will result in a failure of the treatment. The following table summarizes the causes of the beginning of decay in 310 cases observed:

Initial timber defects:	
Defective knots or knot holes	6
Insect holes	3
Adhering inner bark	1
Service timber defects:	
Checks	182
Shakes	65
Mechanical injury:	
Cutting top	36
Axe cut	5
Auger hole	6
Bolt hole	1
Bruise	4
Woodpecker hole	1
Total	310

It is further to be noted that decay occurred in much larger

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proportion with the lighter-colored poles and with those having little or no accumulation of tar at the ground line.

These poles would generally have received a lighter treatment than their mates, and the depth to which they were penetrated by preservative would be less. Obviously the causes of decay listed in the last two groups of the above table would be expected to operate most readily upon the individual poles which were below the average in treatment. No general conclusions as to the cause of decay of completely creosoted poles can, however, be drawn from these data, as the poles showing decay are still a little less than 25% of the poles under observation.

SERVICE TESTS OF PAVEMENTS LAID WITH WOOD BLOCK MADE FROM WESTERN LARCH OR WESTERN TAMARACK.

Spokane, Washington.

LATAH BRIDGE, paved in 1913. 5215 sq. yds. of 4-in. 12 lb. rectangular blocks on 1-in. sand cushion and 5-in. concrete base. Blocks manufactured from partly seasoned lumber, rather green. Pitch filler used with 1-in. expansion joints at curbs and ½-in. transverse expansion joints every 50 feet. No trouble from expansion or bleeding. No maintenance expense. Slight complaint from bleeding until excess filler was worn off. Traffic medium and present condition good.

DAIRY BARN, paved in 1913. 378 sq. yds. of 3-in. 16-lb. rectangular blocks on ¾-in. wet cement-sand cushion and 4-in. concrete base. Blocks manufactured from air-seasoned lumber. Pitch filler used with ½-in. expansion joints in all stalls, etc. Sides and ends of blocks dipped in pitch before laying. No filler applied afterwards. No trouble from expansion or bleeding. Flushed clean twice a day. Present condition good.

TRENT AVENUE, from Division Street to vacated Grant Street, paved in 1914. 13,081 sq. yds. of 3½-in. 12-lb. rectangular blocks on 1-in. sand cushion and 5-in. concrete base. Blocks manufactured from partly air-seasoned lumber, rather green. Pitch filler used with 1-in. expansion joints at curbs and ½-in. transverse expansion joint every 50 feet. Filler not applied on first of work until blocks had been set four days. Weather extremely warm during this interval. Not sufficient filler used on this portion which gave trouble from expansion. $30.00 maintenance expense. Traffic medium and present condition good.

POST STREET BRIDGE, paved in 1914. 872 sq. yds. of 3-in. 16-lb. rectangular blocks on 4-in. plank sub-floor. Sub-floor covered with one layer burlap and coated with asphalt. Blocks manufactured from partly air-seasoned lumber. Asphalt filler used with 1-in. expansion joint at felloe-guard. No trouble from expansion or bleeding. No maintenance expense. Bridge condemned in 1916. Until then traffic had been exceptionally heavy. Condition at time condemned, good.

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CANNON STREET, from Fifth Avenue to Northern Pacific Railway, paved in 1915. 1230 sq. yds. of 3½-in. 12-lb. lug blocks on ¾-in. sand cushion and 5-in. concrete base. Blocks manufactured from partly air-seasoned lumber, rather green. Pitch filler used with 1-in. expansion joint at curbs. No trouble from expansion or bleeding. No maintenance expense. Traffic light and present condition good.

RAILROAD ROUND HOUSE, paved in 1915. 1300 sq. yds. of 3½-in. 12-lb. rectangular blocks on ¾-in. wet cement-sand cushion and 4-in. concrete base. Blocks manufactured from air-seasoned lumber. Pitch filler used with expansion joints around columns, etc. Surplus pitch removed from surface of blocks with hot sand. No maintenance expense. No trouble from expansion or bleeding. Present condition good.

SPRAGUE AVENUE, from Division Street to Hilliard Street, paved in 1916. 2420 sq. yds. of 3½-in. 12-lb. lug blocks on ¾-in. sand cushion and 5-in. concrete base. Blocks manufactured from partly air-seasoned lumber, rather green. Pitch filler used with 1-in. expansion joint at curbs. No trouble from expansion or bleeding. No maintenance expense. Traffic heavy and present condition good.

MONROE STREET BRIDGE, paved in 1916. 550 sq. yds. of 3½-in. 16-lb. rectangular blocks on ¾-in. sand cushion and 5-in. concrete base. Blocks manufactured from partly air-seasoned lumber. Pitch filler used with 1-in. expansion joint at curbs. No trouble from expansion or bleeding. No maintenance expense. Traffic heavy and present condition good.

HOWARD STREET BRIDGE, paved in 1916. 1000 sq. yds. of 3½-in. 16-lb. rectangular blocks on a plank floor. Plank sub-floor covered with two layers of roofing paper and coated with pitch. Blocks manufactured from partly air-seasoned lumber. Pitch filler used with 1-in. expansion joint at felloe-guard. No trouble from expansion or bleeding. Some trouble at first, due to vibration of street-car rails. Traffic heavy and present condition fair, account surface being uneven.

Great Falls, Montana.

CENTRAL AVENUE, from Sixth Street to Ninth Street, paved in 1914, 7919 sq. yds. of 3½-in. 16-lb. rectangular blocks on ¼-in. sand cushion and 5-in. concrete base. Blocks manufactured from air-seasoned lumber. Pitch filler used with 1-in. expansion joint at curbs. No trouble from expansion or bleeding. No maintenance expense. Traffic medium and present condition good.

FIFTH AND SIXTH STREETS, from Central Avenue to First Avenue North, and Seventh and Eighth Streets, from Central Avenue to first alley north, paved in 1914. 5549 sq. yds. of 3-in. 16-lb. rectangular blocks on ¼-in. sand cushion and 5-in. concrete base. Blocks manufactured from air-seasoned lumber. Pitch filler used with 1-in. expantenance expense. Traffic medium and present condition good.

NINTH STREET, from Central Avenue to First Avenue North, paved in 1915. 1871 sq. yds. of 3-in. 16-lb. rectangular blocks on ¼-in. sand cushion and 5-in. concrete base. Blocks manufactured from partly air-seasoned lumber. Pitch filler used with 1-in. expansion joint at curbs. No trouble from expansion or bleeding. No maintenance expense. Traffic medium and present condition good.

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Missoula, Montana.

HIGGINS AVENUE BRIDGE, paved in 1914. 3569 sq. yds. of 4-in. 16-lb. rectangular blocks on 1-in. sand cushion and reinforced concrete base. Blocks manufactured from partly air-seasoned lumber, rather green. Asphalt filler used with expansion joint at felloe-guard. No trouble from expansion or bleeding. Some trouble with vibration. Street-car rails on bridge are too light and are not fastened securely. Vibration from street-car traffic loosens the blocks next to the rails and allows moisture to get underneath. No record of maintenance expense on this portion. Traffic heavy and present condition good, except as noted.

Billings, Montana.

SOUTH TWENTY-SEVENTH, TWENTY-EIGHTH, TWENTY-NINTH, AND THIRTIETH STREETS, ETC. District No. 87, paved in 1913. 23,428 sq. yds. of 3-in. 16-lb. rectangular blocks on 1-in. sand cushion and 5-in. concrete base. Blocks manufactured from partly seasoned lumber. Mixture of asphalt and pitch filler used with two 1-in. expansion joints at curbs. No trouble from expansion or bleeding, except in one instance—slight expansion trouble occurred, caused by creek overflowing during high water and flooding pavement. $5.00 maintenance expense. Traffic medium and present condition good.

NORTH TWENTY-SEVENTH, from Fourth Avenue North to Sixth Avenue North, paved in 1914. 5282 sq. yds. of 3-in. 16-lb. rectangular blocks on 1-in. sand cushion and 5-in. concrete base. Blocks manufactured from partly air-seasoned lumber. Asphalt filler used with two 1-in. expansion joints at curbs. No trouble from expansion or bleeding. No maintenance expense. Traffic medium and present condition good.

Butte, Montana.

IDAHO ALLEY, paved in 1914. 480 sq. yds. of 3-in. 16-lb. rectangular blocks on 1-in. sand cushion and 5-in. concrete base. Blocks manufactured from partly air-seasoned lumber. Pitch filler used with 1-in. expansion joint at sides. No trouble from expansion or bleeding. No maintenance expense. Traffic light and present condition good.

ARIZONA STREET, from Utah Avenue to Great Northern Railway, paved in 1915. 8064 sq. yds. of 3½-in. 16-lb. lug blocks on 1-in. sand cushion and 6-in. concrete base. Blocks manufactured from partly air-seasoned lumber. Asphalt filler used with 1-in. expansion joint at curbs. No trouble from expansion or bleeding. No maintenance expense. Traffic heavy and present condition good.

FRONT STREET, from Utah Avenue to Harrison Avenue, paved in 1915. 3573 sq. yds. of 3½-in. 16-lb. lug blocks on 1-in. sand cushion and 6-in. concrete base. Blocks manufactured from partly air-seasoned lumber. Pitch filler used with 1-in. expansion joints at curbs. No trouble from expansion or bleeding. No maintenance expense. Traffic heavy and present condition good.

All of these blocks, with one exception, were treated with creosote oil, of which the following is a fair analysis:

Specific gravity at 38° C.	1.105
Distillation:	Per Cent.
Up to 150° C.	0.00
Up to 200° C.	0.40
Up to 210° C.	0.90
Up to 315° C.	37.30
Insoluble in benzol and chloroform	1.68

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All of these blocks were treated without a preliminary steaming or vacuum. The method followed was to fill the cylinder and then supply the pressure very slowly until the charge absorbed the correct amount of oil. The oil was used at a temperature ranging from 180° to 200° F. The pressure seldom exceeded 125 pounds. After the oil was removed from the cylinder a vacuum was drawn for from 30 minutes to 1 hour.

All of these blocks were manufactured from western larch, or, as it is known out here, western tamarack. Stock 4 ins. thick and from 6 to 10 ins. wide was used. Now we use no stock more than 8 ins. wide. It is very uniform in growth, with certain exceptions, however, which depend upon the locality in which the stock is cut. We use stock averaging 10 to 15 rings to the inch. We do not buy stock on a ring specification, but control this purchasing from mills that produce the grade we want.

This material, in the form of blocks, when partly air seasoned or green, takes treatment very easily and uniformly. By applying the pressure slowly a very thorough distribution of the oil is obtained. As will be noted, practically all of our blocks are manufactured from partly air-seasoned lumber, so that we are able to get a good distribution of the oil and at the same time deliver the blocks to the work in the best condition for laying.

I believe that western larch, or western tamarack, should be included in the specifications adopted by the American Wood-Preservers' Association as one of the woods suitable for creosoted wood-block paving. I think the service this material is giving now proves it.

It is true that traffic conditions out here are not so severe as those in the East. In instances where western larch blocks have been laid under traffic conditions comparable with those in the East, they have given satisfactory service. Most of our traffic now, however, is automobiles and motor trucks, probably much larger in proportion than in the East.

Another point worth considering is that western larch blocks are not so hard as those made of southern longleaf pine; neither are they as slippery.

MR. P. R. HICKS: I might mention that the records received this year contained very little information on the durability of redwood, and we received very little information on the ties treated with water-gas tar and water-gas tar mixtures. We hope to obtain, if possible, records of that kind later. I move that this report be accepted as information.

MR. O. C. STEINMAYER: I second the motion.

THE PRESIDENT: It has been regularly moved and seconded that the report of the Service Tests Committee be accepted as information. Any discussion? If not, all those in favor please say "aye," contrary, "no." The "ayes" have it.

We have from Mr. Ericson a paper on the "Causes and Prevention of Failures of Creosoted Wood-Block Factory Floors."

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MR. L. T. ERICSON: As Mr. Hicks has already explained, this paper was prepared as a part of the work of the Service Tests Committee.

CAUSES AND PREVENTION OF FAILURE IN CREOSOTED WOOD-BLOCK FACTORY FLOORS.

By Lambert T. Ericson.

The observations and conclusions contained in the following paper are based on a great number of service records and on the personal observations of the writer, who has been fortunate in having been either intimately connected with the construction or the inspection of several hundred thousand square yards of creosoted wood-block factory floors in the past few years.

Creosoted wood blocks are rapidly becoming recognized as the ideal material for mill and factory floors. In spite of occasional failures of floors of this type, architects and engineers are specifying their use in increasing quantities every year. They have received slight notice, as yet, in standard treatises on mill-building construction, but this is bound to be corrected in a very short time. The modern munition plants and other kindred industries which have sprung up in the past three years in connection with the great European conflict, have put creosoted wood-itself with which to enlighten us? The Pennsyvania Railroad Co. block floors to tests which no other type of flooring could withstand.

Our problem today consists in the elimination of the occasional failures, and it is one of extreme importance. They are sometimes rather difficult to analyze on account of the extremely variable conditions in factory buildings.

Every factory manager and engineer today is, in connection with efficiency methods now almost universally being applied, investigating his flooring problems and searching for the ideal floor. We have in creosoted wood blocks this ideal material, and it lies with us to perfect our construction methods and eliminate the failures. This can be done in no better way than by studying the failures that occur, find out the reasons why they failed, and eliminate those features in future construction.

A general rule cannot be laid down which will fit all conditions, but certain general facts and rules can be established which will be of great assitance in preventing trouble, even though the conditions met with vary from those originally anticipated.

Floors of this type very seldom fail from decay. The blocks,

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if properly manufactured and treated and properly installed, wear indefinitely, but when the floors do eventually fail it should be from wear alone. Occasionally, however, they do not give the long and satisfactory service which is expected of them. When premature failure occurs it is usually either from undue shrinkage of the blocks, causing them to become loose or expand, which causes the floor to buckle. Floors subjected to considerable humidity or moisture very frequently fail for the latter reason. In the first case, when the blocks become loose, foreign matter soon sifts between and under them, making the floor very rough and uneven. The blocks then have a tendency to travel with the traffic, and, as they get out of level, soon broom on the end and break up. This condition also permits water to get under the floor, which will aid very materially in the second usual cause of failure, viz., expansion. Expansion at this stage will cause the floor to buckle up, because the joints are full of incompressible dirt and foreign matter. It will cause the floor to buckle at any stage unless the proper provision is made to withstand it.

In relaying the floor after blocks have buckled it is a very difficult job to restore the original surface. Discrepancies of this kind hasten the splintering of the block and destroy the smooth and even surface so desirable and necessary for service and comfort.

Expansion joints, one inch or thereabouts in width, should always be placed along all walls and around columns, machine bases, etc., wherever they can be of benefit. Advantage should be taken of every factor of safety possible. However, expansion joints of this width cannot be placed across the traffic without causing depressions and rough spots in the wearing surface. Inasmuch as creosoted blocks have been known to expand 5% of their volume in passing from the dry to the saturated state, a floor 60 feet in width would, under similar conditions, expand 36 inches. Of course, this percentage of expansion is the extreme limit and improbable to occur; still it is obviously impossible to take care of expansion as a general proposition, successfully, merely by means of expansion joints along the walls, columns, etc., where variable conditions of moisture exist.

The logical and practical way to take care of this expansion is by laying the blocks with individual expansion joints between each and everyone, and filling the joints with a compressible and waterproof material. In rectangular blocks most of this expansion occurs on the ends. The width of end joints required can be calculated very closely, and when this is done, and the requi-

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site provision made as above, no further danger will be encountered from expansion.

The proper relation between the depth and length of the blocks used is also frequently neglected. Experience has proven that the length should never exceed three times the depth. This is especially true of shallow depth blocks, i. e., those 2 inches and 2½ inches deep. There is a very decided tendency for these blocks to curl and warp when of excessive length. Any moisture absorbed from the foundation or cushion by dry block, when accompanied by dry or heated conditions in the building itself, will have a tendency to cause them to curl, due to expansion on the bottom and contraction on the top. Curling will loosen the blocks and destroy their even bearing, causing them to rock and roughen the surface. If the blocks are laid with a bituminous filler between the joints, this condition may correct itself in time. The blocks will straighten out as soon as the moisture content becomes uniform throughout, unless something sifts down under them during the period they are curled. Decreasing the length very materially aids elimination of this faulty feature.

In this discussion we will not go very deeply into the matter of treatment, because, as we have said before, the blocks do not usually fail on account of decay. The proper treatment is an important factor, however, and by proper treatment we mean that the blocks shall be thoroughly impregnated with creosote oil. This can be accomplished by treating to the refusal point by the compressed air, empty-cell method and specifying that not less than 8 lbs. of creosote oil per cubic foot shall remain in the timber. Specifying the use of less oil is rather dangerous, because it leaves a chance that some of the blocks will not be treated to the refusal point. Also a great many treating plants are not equipped with the proper apparatus and facilities to treat to the refusal point, leaving less than 10 to 12 lbs. per cubic foot.

Taking it for granted that the proper treatment has been specified and given, there are still three very essential details which must be observed to insure success. They may be summarized as follows:

First. Thoroughly air-seasoned lumber (for all dry or semi-dry conditions).
Second. An absolutely stable foundation.
Third. A bituminous filler between the joints.

We will consider each one of these three requisites separately.

1.—AIR-SEASONED LUMBER. It is necessary, for success and long life, to keep the blocks tightly cemented together. One of the most essential requirements in this connection, especially where

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dry or heated conditions are to be encountered, is that the lumber shall be absolutely air-seasoned. Inasmuch as untreated lumber will contract more than 6% in volume in drying from the green to the dry state, it should be apparent that there is no possible way to keep blocks tight in the floor if any such condition of shrinkage is to be encountered after their installation. That would mean that a block measuring 4 inches wide by 8 inches long would contract ¼ inch in width and ½ inch in length in drying out. It is a fact that well air-seasoned lumber will shrink further when subjected to steam-heated conditions, but it is possible to offset this shrinkage by the use of a plastic filler between the joints.

Floors that are to be constantly subjected to moisture or to humid conditions are an exception to this rule. They should be preferably manufactured from only partially seasoned lumber, or, if dry lumber is used, it should be subjected to live steam, to swell the blocks during the treatment. This condition, however, is not a usual one, and merely illustrates the impossibility of laying down rules that will fit all cases. It is also frequently advisable to use a heavier oil treatment.

This brings up the allied subject of proper handling of the blocks after they are treated and before they are installed in the floor. Taking it for granted that the blocks are absolutely air-seasoned and thoroughly treated by the empty-cell process with creosote oil, if they are allowed to be hauled or stored out in the open and subjected to rain, snow or ice, and then not dried out preliminary to installation, you may be pretty sure that they have absorbed considerable moisture, thereby expanding, and that later undue shrinkage is apt to occur. This has, without a doubt, been the cause of a number of floor failures, where all the other details of manufacture and construction have been carefully and properly carried out.

Likewise blocks intended for wet places that are allowed to dry out after treatment are liable to cause buckling troubles after they have been installed.

When blocks are to be installed in hot or unusually dry conditions, such as furnace and annealing rooms, it is advisable, wherever possible, to pile them up inside under similar conditions and subject them to as much drying as possible before laying them.

2.—REQUISITE STABLE FOUNDATION. The matter of the foundation for the floor is also very important. It goes without saying that if the foundation gives way the block pavement will do likewise. Failure of the foundation is very often attributed to the material in the wearing surface, because the real evidence is covered up.

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Concrete of the requisite depth and proportions to withstand the load to be imposed should always be used, unless out of the question from other standpoints. If timber is used it should be given a preservative treatment to obviate decay. In modern factory construction, however, it is very rarely the case that concrete cannot be used.

The advisability of the use of a cushion between the concrete and the blocks is a matter of much debate. It should be remembered that when one is used its sole function is to level up the inequalities of the concrete base, to afford the blocks an even bearing and to permit them to be surfaced smooth by rolling or tamping. In a great many cases the use of a cushion is necessary for this latter reason, especially if a smooth-finished floor is desired. Most specifications permit a variation of $\frac{1}{8}$ inch in the depth of the blocks, and this variation is very likely to occur, even when the blocks are cut by the latest approved types of block machines. A cushion will take care of this variation in the depth of the blocks.

Floors frequently fail, due to the shifting of the cushion. For that reason it is most advisable to use one composed of dry mortar, and it should not average more than ½ inch in depth. The concrete in this case should be finished level, and even enough so that the depth of the cushion will not vary more than ¾ inch. It should not be over 1 inch in depth at the maximum point, nor less than ¼ inch at the minimum. It should consist of one part cement and four parts sand, thoroughly mixed and spread fairly dry. Care should be taken to see that it is evenly and densely distributed. Enough water should be sprinkled over it, just ahead of laying the blocks, to insure the setting of the cement.

Sand alone is frequently used for a cushion, and it is very often permitted to be of an excessive depth. It has not been unusual in the past to see blocks installed on sand cushions averaging 2 inches in depth which, in places, would measure as much as 4 inches. A cushion should never be used to cover up a bad and rough piece of concrete base. Where there is not vibration and where the floor is level a thin sand cushion will serve the purpose admirably, if evenly applied, and not over 1 inch in depth at the maximum point. However, the addition of cement is a precaution well worth the expense. Care must be taken, however, in that case to see that enough moisture is added after spreading to cause the cement to set; also, that the blocks are tamped smooth before the setting takes place.

Where the expense and trouble is not too great, where moisture under the floor is to be expected, or where the traffic is un-

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usually heavy, it is good practice to finish the concrete to a smooth and level surface exactly the depth of the block below the finished floor level, not allowing for a cushion. This is also good practice where the depth of the block used is less than 3 inches. Care must be taken to see that the base is absolutely smooth and true in surface. Blocks laid directly on the concrete cannot be tamped and require an even bearing in order to prevent them from splitting under traffic. A big advantage in finishing the concrete smooth is the fact that there is absolute assurance it will not be a failure, due to a shifting cushion or a poorly finished concrete base. The blocks can be laid directly on the concrete base, except where moisture is expected to be encountered from beneath, or where acid solutions are to be used. In that case it is well to coat the smooth concrete base, after it has dried out, with a thin and even coating of coal-tar pitch, allowing the pitch to harden before laying the blocks thereon.

Either the dry mortar cushion method or smoothly finished concrete base method, with or without the coating of pitch, will, if properly carried out, give good results. They all have their advantages. They all afford an immovable and stable foundation for the blocks. The dry mortar cushion permits the concrete base to be installed with less care and expense, permits it to be used as a wearing surface during the preliminary stages of the building construction, without having to be touched up and refinished just ahead of the laying of the blocks, and permits the blocks to be tamped or rolled to a smooth, even surface after laying. A cushion is not necessary, however, for the purpose of absorbing the vibration of traffic; the fiber of the wood can be relied on for the necessary resilliency. Blocks laid directly on a smoothly finished concrete base, whose joints are thoroughly filled to their full depth with a bituminous filler, are as solid as the base itself. The pitch coating affords waterproof protection from moisture under the base and also a certain amount of adhesion of the blocks to the base.

The absolutely rigid support afforded by the elimination of the cushion insures that shallow blocks from 2 inches to 2½ inches in depth will keep their surface without any material pressure to contend with, and will, in a great many cases, give service equal to those of greater depth.

3.—BITUMINOUS JOINT FILLER. More floor failures can be directly traced to the use of sand as a joint filler or to the use of no joint filler whatever than to any other cause.

The necessity of using a bituminous joint filler is fully as important as the two preceding requisites. Its use is absolutely

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necessary to cement the individual blocks rigidly and tightly in place under the varying conditions of moisture to be encountered. As long as they are so held in place there is absolutely no doubt as to the service which will be obtained therefrom. They will soon bind together into a monolithic mass, which will wear indefinitely. It is then impossible for dirt, foreign matter or moisture to get underneath, and such a floor is immune to sprinkling or accidental flooding with waten In other words, it is more or less waterproof.

From the standpoint of the prevention of buckling, due to expansion, it has already been pointed out that it is necessary and desirable to lay the blocks with individual expansion joints wherever there is the remotest chance of moisture being encountered. Since flooding, due to water pipes breaking and similar accidents, is apt to occur at any time, even in dry interiors, it is usually wise to provide this factor of safety. These individual expansion joints should be filled to their full depth with a bituminous material which will at one and the same time expand and contract with the integral units, bind them together and make the surface waterproof.

Experience has proven that, under the usual factory conditions, it is impossible to hold blocks tightly in place by the sole means of a bituminous cushion applied to the concrete base under the blocks. The bond between the pitch and the concrete is not very secure, and when once broken does not tend to renew itself. Sand is often used as filler when the bituminous coating is used under the blocks, and sometimes no filler is used at all. This procedure is sooner or later sure to result in trouble. As soon as a block gets loose it quickly gets out of level, due to the sand used in the joint, or dirt sifting down underneath. This condition soon communicates to the surrounding blocks, and a rough, shifting surface results. Any water coming in contact with the floor will then settle under the block and remain there until evaporated or taken up by the wood fiber, very often resulting in buckling.

Care must be taken to see that the filler used in the joints is of the proper melting point. It should not become soft under the temperature to be encountered; otherwise it will have a tendency to flow underneath and be of no further use. Under ordinary conditions the proper melting point is between 145° and 150° F. Where abnormally hot conditions are sure to be encountered it should have a higher melting point. Placing a small amount of sand or dry cement grout in the bottom of the joints is a very good means of preventing the filler from flowing underneath, but care should be taken to see that too much is not used.

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Either coal-tar pitch or asphalt may be used. Coal-tar pitch is usually advisable, both on account of being more easily obtained and being better adapted for the purpose. Creosote oil and coal-tar pitch amalgamate better, and the adhesion of the coal-tar pitch to the blocks is greater than that of any other materiai that has been used. It adheres to creosote block like glue and cements the blocks very tightly together.

The great difficulty to be encountered in connection with the use of the bituminous-joint filler for a floor to be subjected to dry conditions is the fact that the blocks must be laid as closely together as possible. That condition makes it very difficult to introduce the filler into the interstices in sufficient quantity and to their full depth. Special means, however, can be provided to accomplish this result and great care should be taken to see that it is attained.

The filler should be heated to the point where it is thoroughly liquid and flow like water. It should be flushed into the joints from the top, using a hard rubber-edged squeegee to force it into the interstices and to leave only a light film on the surface. After the joints have been properly filled the surface should be covered with sharp, dry sand and the sand permitted to remain, if possible, for a period of three or four weeks. The light film of bituminous filler left on top will, if of the proper melting point, be worn off and into the surface by the traffic within that time. If any surplus remains when the sand is removed and it proves soft and obnoxious, it can be removed by means of hot sand or hot irons.

Fear of obnoxious conditions resulting from the use of the bituminous filler have frequently resulted in its elimination by the owners or the engineers. It is absolutely ungrounded, however, if the work is done by competent and experienced pavers or properly supervised by them, and its use should, accordingly, be insisted on. If necessary, a guarantee should be given that it will not prove obnoxious.

In conclusion, I wish to leave this plea with the manufacturers of interior creosoted wood-block floors, with the hope that, with their help, most of the failures will be eliminated in the future: Place on your staffs engineers and competent foremen, and give them a chance to supervise the installation of your materials. Make service your slogan. Do not permit the idea to go broadcast that any mason or jack-of-all-trades can successfully install your floor. It is work, simple enough, perhaps, when understood, but which has many loopholes in which danger lurks. Do not let a novice spoil the work and thereby the business which we

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are all striving so hard to develop. Let us avoid the pitfalls which nearly arrested, in its infancy, the growth of creosoted wood-block street paving.

THE PRESIDENT: Gentlemen, you have heard Mr. Ericson's paper. Does anybody have any remarks to make in reference to it?

MR. WALTER BUEHLER: Mr. President, I think Mr. Ericson's paper emphasizes one point that the Committee attempted to bring out this morning in its report on interior wood-block floors, the absolute necessity of defining interior floors. He spoke of one case of a failure due to an expansion and another case of a failure due to contraction. The failure due to expansion probably resulted from the use of material that was too thoroughly seasoned before it was put in. He spoke of precaution being necessary to see that the blocks are not piled too long and do not dry out too much before they are laid, that is, where the block is to be laid in an environment that is going to be moist. Then if your failure is to be due to contractions, the blocks must be thoroughly seasoned before they are laid, and care must be taken that they are not exposed before they are put in the floor.

You have two definite problems, and you have to study your floor carefully before you make the recommendation as to the kind of block you are going to use on the floor. I believe if that one point is emphasized and thought of in the design of the floor we will eliminate a great many failures.

Mr. Ericson spoke of the practice of putting sand into the joint where the bituminous filler is going to be used. That sounds all right in theory and will work out in practice sometimes if the man that you have doing the work is exceptionally skillful. Nine times out of ten it is not possible to put sand into the joint and get only a little at each joint. I have watched this operation a great many times, and I find what actually does take place is a little sand in the bottom of one joint with the joint near it completely filled with sand. The result is you get one joint with bituminous filler in it and right close another joint with no bituminous filler. There is no practical way of spreading that sand over the pavement and getting a little at the bottom of each joint. If that were possible, if some practical way could be worked out to make that possible the theory is all right, but in most of the cases that I have seen the actual operation does not work out according to theory.

MR. L. T. ERICSON: I wish to say that I have had a little experience in applying the sand to the bottom of the joint and I have found the difficulty that Mr. Buehler speaks of, but I have overcome it to a certain extent by being careful to sprinkle only sufficient sand

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on top of the block so that in brooming it in it does not accumulate in a pile; also by sprinkling it on and not brooming it in for a half hour or so, thereby letting it dry out. If it is sunny weather it will dry out. If it is wet weather it is not advisable to put it in at all. However, I learned last night of the experience of one of the eastern street railway engineers in connection with paving wood blocks between car tracks. He had a great deal of difficulty with the pitch filler going down underneath the blocks, probably due to vibration. He tried a number of methods to prevent this. First, he laid the blocks directly on the concrete with a mop coat of pitch and a pitch filler, and he had trouble with the blocks arching up in that case. Then he laid them on a mortar cushion and swept in a little sand before he applied the pitch filler, and he found that the blocks still arched up a little bit and the sand at the bottom of the joints would get down underneath the blocks and cause the surface to get rough. Then he adopted a 3-1 mortar, mixed dry, in place of the dry sand, and he spread that on top of the blocks and broomed that in before he applied the pitch filler, and he has had excellent results with that method, better than anything he has ever tried. That is in New York City. It is new to me, but it sounds reasonable.

THE PRESIDENT: Any further remarks on this paper? If not, we will hear from Mr. Teesdale on the Condition of Creosoted Wood-Block Pavements in Mobile, Ala.; Shreveport, La., and a Number of Texas Cities.

CONDITION OF CREOSOTED WOOD-BLOCK PAVEMENTS IN MOBILE, ALA., SHREVEPORT, LA., AND A NUMBER OF TEXAS CITIES.

By C. H. Teesdale.

In Charge, Section of Wood Preservation,
Forest Products Laboratory, Madison, Wis.

Purpose.

An inspection of wood-block pavements was made in Shreveport, La., Mobile, Ala., and a number of Texas cities in the early spring of 1917 to obtain information on the experience with various methods of treating and laying wood block, and more especially to learn the cause for the unusual amount of trouble these cities were having with wood block. The following cities were visited:

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Cities Visited.

Shreveport, La.	Houston, Texas
Austin, Texas	Longview, Texas
Beaumont, Texas	San Angelo, Texas
Dallas, Texas	San Antonio, Texas
Fort Worth, Texas	Waxahachi, Texas
Galveston, Texas	Wichita Falls, Texas
Greenville, Texas	

Data Obtained.

Whenever possible data were obtained on;

1. Date pavement was laid.
2. Number of square yards laid.
3. Width of roadway.
4. Cost of pavement per square yard.
5. Kind of traffic (light or heavy).
6. Number of car tracks (if any).
7. Name of contractor.
8. Depth of blocks.
9. Depth of concrete base.
10. Kind of cushion used.
11. Kind of filler used.
12. Place where blocks were treated.
13. Kind of preservative used.
14. Method of treatment.
15. Absorption in pounds per cubic foot.
16. Trouble experienced since pavement was laid.

A trip with the City Engineer in each city was made over the streets paved with wood block and a careful inspection made of streets selected as typical. Copies of the specifications and inspection reports were obtained from the files of the city whenever they were available. In some cases, where no information could be obtained from the city files, access to the inspection reports was given by the bureau that inspected the blocks; in other cases some information was obtained from the treating plant records. A portion of the data was obtained from the contractors handling the work. In spite of the fact that all of these sources of information were used, it was not always possible to obtain complete records.

The writer desires to take this opportunity to express his sincere appreciation for the many courtesies extended to him and for the excellent cooperation and assistance which was so freely given and without which it would not be possible to prepare this report.

Summary of Inspection Data.

Most of the pavements inspected were laid within the last six years. Southern yellow pine was used in all cases, and usually the treating records showed that the blocks were green and were steamed before treatment. The earlier pavements were treated with heavy tar oils. From 16 to 20 lbs. of preservative per cubic foot was injected. The

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pavements were usually laid on sand cushions and filled with sand fillers.

The development of very serious expansion trouble in these pavements led to a quite universal change in the specification early in 1915. Imported English distillate oil was substituted for the heavy paving oils and the blocks were laid on a mortar cushion and filled with asphalt filler. As a rule, green timber steamed before treatment was used as before.

Discussion of Results.

Sixty-one pavements were investigated, but four of these, originally laid with sand cushion and filler, were relaid using bituminous filler, and are counted twice in Table 1, giving 65 in all. Thirty-two were treated with heavy tar oils and 33 with light oils; 35 had sand filler and 30 bituminous filler. Table 1 is a summary of the number, kind, and condition of pavements which were inspected. Swelling troubles which necessitated relaying considerable areas of pavement are included in the column of "Serious trouble," while all other cases of expansion which were found or reported are included under "Slight trouble." Tables 2a and 2b give the details of treatment, construction, and the experience obtained on each of the contracts investigated.

Table 1 shows that of 35 pavements laid with sand filler and cushion 23 gave serious trouble and 8 gave slight trouble from expansion. Only 3 pavements of the 35 gave no expansion trouble, and one of these had been in service but a few weeks when inspected. The blocks had bled severely in each of the three exceptions, which probably helped to waterproof the surface.

Thirty pavements were laid with bituminous filler, 20 of them on mortar, and 10 on sand cushion. None gave serious trouble from expansion; 4 gave slight trouble, and 26 gave no trouble. Of the 4 giving slight trouble, 3 were laid on sand cushions; one of them between the rails of a street railway, one other used liquid petroleum instead of asphalt or pitch for filler, and the other cases both occurred on bridges.

It will be noted that of 32 pavements treated with distillate oils, 23 were laid with bituminous filler; and of 33 treated with heavy tar oils, only 7 were laid with bituminous filler. Serious trouble occurred with either oil when sand filler was used and did not occur when bituminous filler was used. In 4 cases, where the blocks were originally laid with sand filler, so much trouble was experienced that the entire pavements were relaid, using bituminous fillers, and no further trouble developed.

There is little doubt that nearly all of the expansion trouble, and in every case where it was very severe, was due to the use of sand fillers. Good and poor results were obtained with both light and heavy oils,

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and none of the trouble that has thus far occurred from expansion can in fairness be attributed to the kind of oil used.

It can be readily seen that when a sand filler is used water can penetrate the spaces between the blocks and is absorbed by the wood. This can be retarded, but not prevented, by creosoting the blocks, as creosoted wood readily absorbs water and as readily dries out. If the blocks are laid dry and the sand filler is tightly packed some form of buckling or expansion trouble is certain to occur during wet weather when the blocks take on moisture. During the succeeding dry weather the blocks will dry out and shrink, the spaces between them will again become filled with sand which is tightly packed, and at the next rain further expansion trouble will occur. The result is that in time the courses will be forced out of alignment and if there is not room for further expansion there is the possibility of bulging, displacement of the curb, and numerous other results of expansion trouble. In order to prevent this difficulty it would seem absolutely essential to make the pavement waterproof. The experience of the various cities visited seems to show clearly that satisfactory results are not obtained with sand fillers.

Much less difficulty was experienced with the sand cushions but sufficient trouble could be traced to this method of construction to warrant the somewhat greater expense of using a mortar cushion. This is particularly true where street cars traverse the pavement. Wherever there is considerable vibration sand cushions are liable to shift and produce an uneven surface, permitting movement of the blocks; and in case of accidents, such as a broken water main or excessively heavy rain sand is liable to be washed from beneath the blocks and result in an entire displacement of the pavement.

An uneven surface was found in a few cases where the blocks were laid on sand cushion and filled with bituminous filler. This resulted from shifting of the cushion due to vibration. In one case in Fort Worth, Texas, a water main broke and washed the sand from beneath the blocks and necessitated the relaying of a considerable area of the street. A similar accident in another location where mortar cushion was used had no effect on the pavement. In most cases a mortar cushion would probably be superior to a sand cushion. It does not become saturated with water as does the sand cushion, and it affords a firm foundation for the blocks. It would seem that the use of sand cushions entails considerable risk, which is not warranted by the very slight saving in cost of construction.

On a number of streets having street car tracks the blocks were found to have caused trouble by bulging between rails. Blocks laid along street railways should have ample provision made for expansion

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and drainage, as conditions are more severe than on other sections of the pavement. Extra care should be used in laying such blocks to see that they are not laid too tightly and that the surface is thoroughly sealed against the entrance of water. Much of the trouble noted was due to poor track construction, which permitted vibration in the rails. It is practically impossible to lay a satisfactory wood-block pavement in street railway tracks where the construction is not good. Neither wood-block paving nor any other form of paving can be expected to last under such conditions.

While most of the streets inspected were from 25 to 50 feet in width, some of the cities had streets 70 ft. wide. It is quite a problem to provide for expansion in such broad streets, and unless extra care is exercised trouble is liable to develop. Several of the smaller cities having a population of from 5,000 to 15,000 had very broad streets. It is not only difficult to obtain satisfactory results with wood-block paving on such wide streets, but the cost is very high. The paved area might be reduced by some provision, such as parking in the center.

It was found that the wood-block pavements on streets with heavy traffic were less subject to expansion troubles than those in small cities or on light traffic residence streets. For this reason it is not always safe to assume that the same allowance for expansion will be suitable for streets under different traffic conditions. Some of the conditions found are illustrated in Figs. 1 to 13. All of the photographs were taken in February and March, 1917.

Fig. 1. Wichita Falls, Texas (Ohio Avenue). View showing spreading of blocks due to expansion. These blocks were laid in 1911 on a sand cushion with sand filler.

Fig. 1 shows a pavement where the blocks were not held in position by a curb; some of the spaces between the blocks, originally closely laid, are over 1 inch in width. These spaces are widest at the center of the street.

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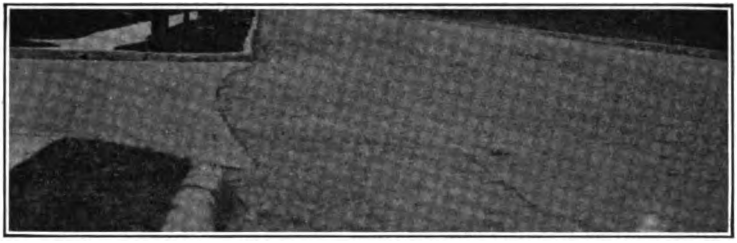

Fig. 2. Shreveport, La. (Cresswell Street). Adjoining pavement pushed back at a street intersection. Blocks laid on a sand cushion with sand filler. Street laid in 1912.

Fig. 2 shows an asphalt pavement pushed back several inches by expanding wood block. The curb has also been shoved back and is out of line.

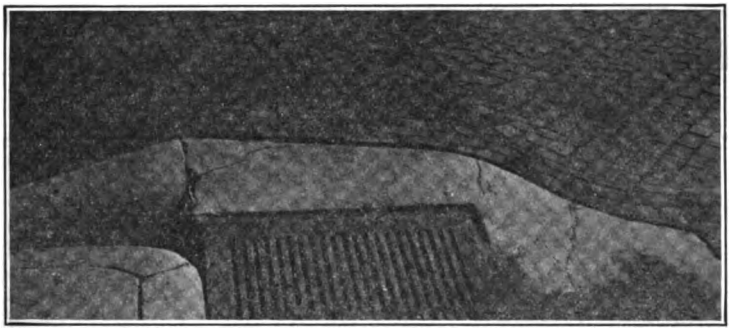

Fig. 3. San Angelo, Texas. Condition of storm-sewer drain due to expansion. Blocks laid on sand cushion with sand filler in 1913.

Fig. 3 shows a storm sewer damaged by expansion of the pavement.

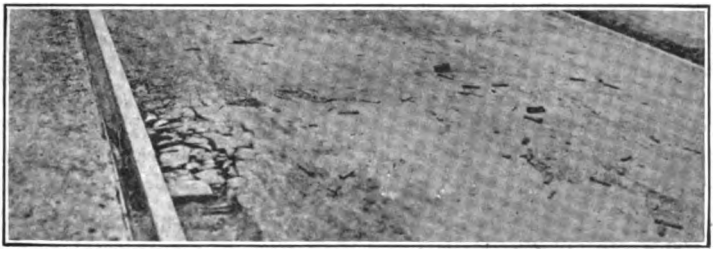

Fig. 4. Beaumont, Texas (Washington Street.) Destruction of blocks caused by working of joint on steam-railroad track. Pavement was laid in 1911.

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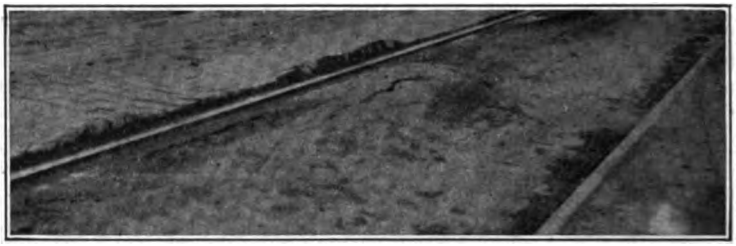

Fig. 5.

Fig. 6.

Fig. 7.

Figs. 5, 6, and 7. Houston, Texas (Washington Street near Heights Boulevard.) These photographs show the various stages of disintegration of wood block between street-railway tracks, due to bulging. Pavement laid on sand cushion with sand filler in 1911.

Figs. 4 to 7 show the destruction of wood block in street-railway track, due to vibration and poor construction methods. Fig. 4 shows a steam railroad on a city street where the vibration is so heavy that wood-block pavement cannot be satisfactorily used. Figs. 5 to 7 show the successive stages in the disintegration of wood block when laid in street-car tracks on a sand cushion, and filled with sand.

Fig. 8 is a general view of a street in San Angelo, Texas, where 44,000 yards of wood-black pavement practically disintegrated in less than 4 years. This trouble was due to construction methods, the blocks

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being laid on sand cushion and with sand filler. Over 25% of the individual blocks are broken and must be replaced when the pavement is relaid.

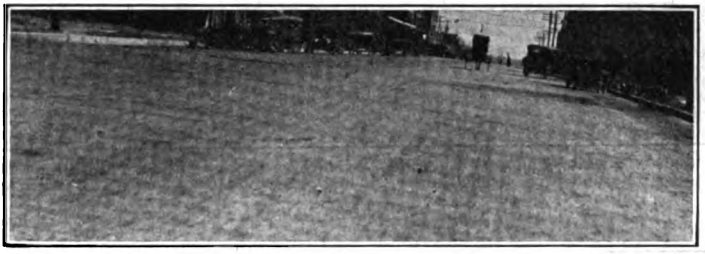

Fig. 8. San Angelo, Texas (West Twohig Avenue.) View showing general street conditions. Note broad street, all paved with wood block. Pavement was laid on sand cushion with sand filler and has given considerable trouble from expansion. Blocks were laid in 1913.

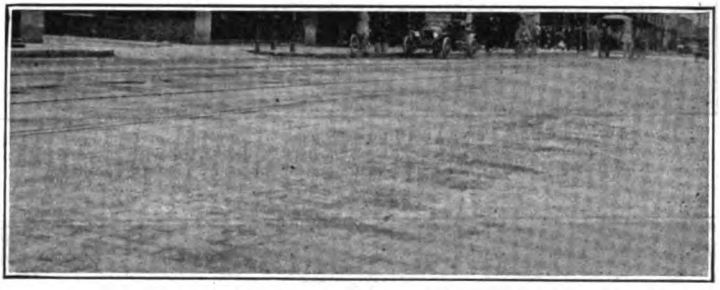

Fig. 9. Beaumont, Texas (Pearl Street.) Pavement laid in 1911 on sand cushion with asphalt filler. In excellent condition.

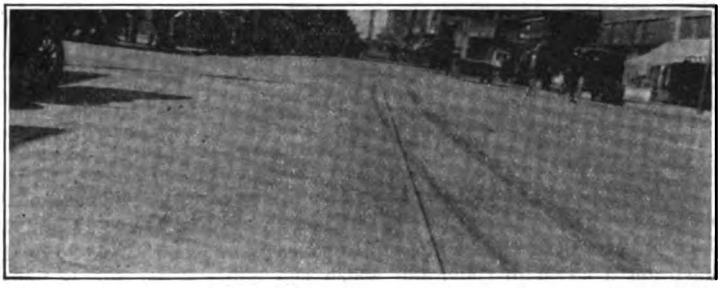

Fig. 10. Fort Worth, Texas (Houston Street.) Pavement laid in 1913 on sand cushion with asphalt filler. Street is in excellent condition.

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Fig. 11. Wichita Falls, Texas (Ohio Avenue.) Blocks laid in 1913 on a sand cushion with asphalt filler. This pavement has given no trouble and surface is excellent.

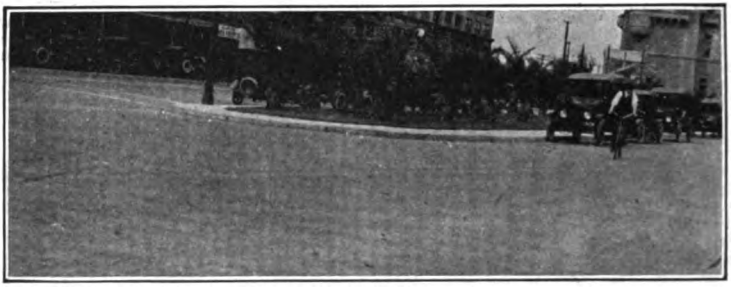

Fig. 12. San Antonio, Texas (Military Plaza.) Showing method of parking to lower paving cost. Roadway is 70 ft. wide. Laid with mortar cushion and asphalt filler in 1915. This pavement is in perfect condition.

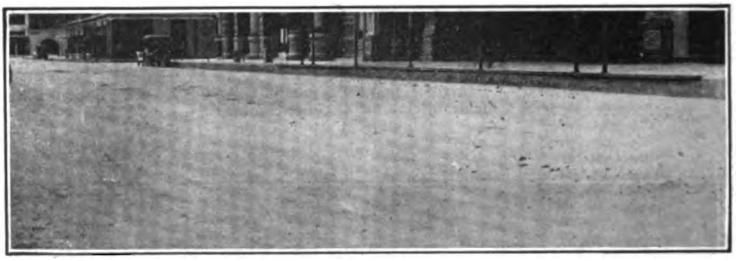

Fig. 13. Galveston, Texas (Avenue B.) Laid on mortar cushion with asphalt and sand filler. This pavement was under water for 48 hours, the maximum depth being 5 feet. The blocks gave no trouble, even under this severe test. Blocks were laid in 1914.

Figs. 9 to 13, inclusive, show typical pavements where asphalt fillers were used, and with very satisfactory results. Figs. 11 and 12 show streets 70 ft. wide successfully paved with wood block. Fig. 13 illustrates a street in Galveston which was under water for 48 hours during the 1915 storm, the depth of the water at one time being 5 feet.

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The pavement was not injured and was in perfect condition when photographed.

Conclusions.

An analysis of the data obtained in the above study leads very strongly to the conclusion that the expansion trouble found was due to construction faults, and not to materials. Nearly all pavements laid with sand filler gave trouble from expansion. Very little trouble was found where bituminous fillers were used. This was true, whether light distillate or heavy tar oils were used. The blocks, in general, were very well treated and there was very little evidence of trouble resulting from poor treatment, or to the quality of oil used. Sufficient trouble from shifting sand cushions was noted to condemn this method of construction. The slight saving in cost compared with mortar cushions would not warrant the risk of trouble. The numerous satisfactory streets where proper construction methods were used prove that wood block can be successfully used in Texas cities if proper methods of construction are adopted.

TABLE 1.—SUMMARY OF CONDITION OF PAVEMENTS INSPECTED. *a*

Results secured	Distillate oil			Heavy oil		
	Sand filler	Bituminous filler		Sand filler	Bituminous filler	
	Sand cushion	Mortar cushion	Sand cushion	Sand cushion	Mortar cushion	Sand cushion
Serious trouble from expansion.....	6	..	..	17	..	..
Slight trouble from expansion.....	2	1*c*	..	6	..	3*b*
No trouble from expansion*e*.....	1	16*d*	6	2	3	1
Trouble from shifting cushion*f*.....	..	..	..	1	..	..

*a*The numbers in each column represent the number of individual contracts. The table includes six pavements that were counted twice the second time, because they were relaid with bituminous filler, or streets investigated in each case.

*b*One case of trouble was due to use of sand cushion in street-car tracks, one was on a bridge, and the third used crude oil and sand for filler.

*c*This pavement laid on a viaduct. Trouble was not serious.

*d*Eight of these were filled with asphalt and sand.

*e*Laid on mortar cushion with sand filler.

*f*Includes only those where expansion trouble did not occur.

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Table 1.—Inspection of Wood-Block Pavements

City.	Record No.	Location in city.	Date laid.	Kind of cushion.	Kind of filler.	COMMENTS ON PAVEMENTS					Other remarks.
						Bleeding.	A Buckling B Bulging or C Swelling.	Decay.	Expansion.	Shifting cushion.	
Mobile.....	1	St. Louis, first block to St. Joseph.....	1905	1' Sand	Sand		B	Not over 1% in sapwood.	Yes		
"	2	Claiburn, from Church to State...	1905	"	"		"	"	"		
"	3	Conception from St. Louis to St. Anthony.....	1905	"	"		"	"	"		
Shreveport.....	1	Milan.....	1910	"	"	Very severely 1st and 2d yr.		Under side removed	Started 1916		
" "	2	Marshall, 7th to.... Stover; Davis to 7th.....	1912	"	"		C. displaced curb.	No.	Soon after laying.		Partly relaid since 1914 with asphalt filler.
"	3	Cresswell, Wichita to Olive.....	1912	"	"				Yes.	Yes.	
"	4	Cresswell, Herndon to Wichita.....	1912	"	"				"	"	
"	5	Market, between Milan and Travis.	1912	"	"				"	"	
"	6	Market, between Milan & Crockett.	1912	"	"	Yes.					
"	7	Market, between Texas and Travis..	1912	"	"	Yes worst 1st & 2nd years.			"		
"	8	Market, between Milan and Texas..	1912	"	"	Yes.	B			"	

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Table 1.—Inspection of Wood-Block Pavements—Continued.

City.	Record No.	Location in city.	Date laid.	Kind of cushion.	Kind of filler.	COMMENTS ON PAVEMENTS. Bleeding.	A Buckling B Bulging or C Swelling.	Decay.	Expansion.	Shifting cushion.	Other remarks.
Austin	1	Alleys E. and W. of Congress from 5th to 7th	1912	1" Sand	Sand	Heavily					
"	2	East 6th Street railway only	1913 1914	Sand	Asphalt pitch				Considerable in 1913		Poor penetration 1913. Very little trouble 1914
"	3	Fourth	1912	Over 1" sand	Sand		B. Considerable		Considerable		Less trouble now.
"	4	Bridge	1909	1" Sand	Pitch				Slight		
Beaumont	1	Main, Washington to Forsythe, at City Hall	1911	"	Sand	"					
"	2	Pearl, through down-town district	1911	"	Asphalt	Severely					Street in perfect condition.
"	3	Various streets	1912 1913	"	Sand		B.			One street treated with heavy tar oil; laid with asphalt filler disintegrated; vibration of a steam railway.	Some blocks washed up by heavy rains in 1915. Relaid with asphalt filler; no trouble.
Dallas	1	Oak Cliff viaduct	1914	1" mortar	Asphalt		C.				At one or two points necessary remove blocks along curb.
"	2	Lancaster, Brazos to 10th	1913	1" Sand	Sand		A. 1 yr. after laying				No trouble since repairing.

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Table 1.—Inspection of Wood-Block Pavements—Continued.

City.	Record No.	Location in city.	Date laid.	Kind of cushion.	Kind of filler.	COMMENTS ON PAVEMENTS.					Other remarks.
						Bleeding.	A Buckling B Bulging or C Swelling.	Decay.	Expansion.	Shifting cushion.	
Dallas.....	3	Tenth, Lancaster to Bishop.....	1913	1" Sand	Sand				Considerable after first year laid		Curb displaced; relaid about 200 sq. yds. Surface now excellent.
"	4	Tenth, Bishop to Winetka.....	1914	1" Mortar	Asphalt						Excellent surface.
"	5	Lamar, Pacific to McKinney.....	1915	"	"						" "
"	6	Cochrane, Lamar to Griffin.....	1914	1" Sand	"						" "
"	7	Grand Ave., between Erray and Expos. Ave.....	1912	"	Sand	2 years after first month laying	A. 6 to 9 mos. after laying				
"	8	Young.....	1914	"	Asphalt						No trouble.
"	9	Houston, in front of Union Station.....	1912	"	Sand		C. 1 yr. after laying				Surface now good.
"	10	Bryan, between St. Joseph and Munger	1915	"	Asphalt						No trouble.
"	11	Hawkins, bet. Commerce and Bryan.	1915	"	"						"
"	12	Parry, bet. Expos. and Haskell.....	1912	"	Sand					Began 1917	
"	13	Bryan, bet. Pacific and Cantegral.....	1912	"	"		A. Not serious	Sapwood. Less than 1%		Yes	

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Table 1—Inspection of Wood-Block Pavements—Continued.

City.	Record No.	Location in city.	Date laid.	Kind of cushion	Kind of filler.	COMMENTS ON PAVEMENTS. Bleeding.	A Buckling B Bulging or C Swelling.	Decay.	Expansion.	Shifting cushion.	Other remarks.
Dallas	14	Bryan, Cantegral to St. Joseph	1912	1" Sand	Sand		A.			Yes	
"	15	Elm, Erby to Harwood	1915	Mortar	Asphalt						Surface excellent. No trouble.
"	16	Stone, Main to Elm	1908	2" Sand	"						" "
"	17	Commerce, Harwood to H. & T. C. tracks	1910	1" Sand	Sand		"		Severe		Resurfaced 1915; mortar cushion, asphalt filler.
"	18	Commerce, Jefferson to Harwood.	1911	"	"				"		" "
"	19	Cochrane, Griffin to McKinney	1913	"	"				Yes	"	Relaid from rail to gutter.
"	20	Elm, Market to Erby	1911	"	"				"		Trouble within month after laying. Relaid entirely 1915; mortar cushion, asphalt filler. No trouble now.
"	21	Elm, Harwood to H. & T. C. tracks	1911	"	"				"		Trouble began 2 years after laying. Surface rather rough.
Fort Worth	1	Houston St	1913	Sand	Sand				Not much		Good surface. Relaid one city block as sand cushion washed out by broken water main. A mortar cushion would have prevented necessity of relaying.
"	2	Main St	1916	½" Mortar	"						Surface excellent.

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Table 1—Inspection of Wood-Block Pavements—Continued.

City.	Record No.	Location in city.	Date laid.	Kind of cushion.	Kind of filler.	COMMENTS ON PAVEMENTS.					Other remarks.
						Bleeding.	A Buckling B Bulging or C Swelling.	Decay.	Expansion.	Shifting cushion.	
Galveston.....	1	29th St., Ave. E to F.....	1915	1" Mortar	Asphalt and sand						Good condition.
"	2	Ave. B, 23rd to 24th	1914	"	"						"
"	3	37th St., Ave. F to H	1915	"	"						"
"	4	Ave. F, 21st to 22nd	1915	"	"						"
"	5	Ave. F, 23rd to 24th	1914	"	"						"
"	6	Ave. F, 29th to 30th	1915	"	"						"
"	7	Ave. F, 33rd to 34th	1915	"	"						"
"	8	37th St., Ave. B to F	1916	"	"						"
Greenville.....	1	Various streets.....	....	Sand	Sand		B.			Yes	Most trouble along car track which has poor foundation.
Houston.....	1	Washington, near Heights Blvd.....	1911	1" Sand	Sand		A. Considerable		Considerable		Blocks broken by heavy traffic No expansion joints used.
"	2	Heights Blvd., near Washington.....	1912	"	"				"		Since 1913 considerable laid; mortar cushion, asphalt filler. Excellent satisfaction.
Longview.....	1	Main St.....	1911	"	"		C. Very severe				About 40% relaid since 1913; sand cushion, sand filler. Very bad condition; heavy maintenance.
San Angelo.....	1	Various streets.....	1913	"	"		A. Frequent breaking 15 to 40% of blocks		Started at street railway tracks 9 months after laying		Resurfacing necessary at an early date. Small section relaid with mortar cushion. asphalt filler; no trouble since.

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Table 1.—Inspection of Wood-Block Pavements—Concluded.

City	Record No.	Location in city.	Date laid.	Kind of cushion.	Kind of filler.	COMMENTS ON PAVEMENTS.					Other remarks.
						Bleeding.	A Buckling B Bulging or C Swelling.	Decay.	Expansion.	Shifting cushion.	
San Antonio.....	1	Military Plaza E. side.....	1915	Mortar	Asphalt						Excellent condition.
"	2	Ave. C, Houston to Grand.....	1916	"	"						"
"	3	Houston, Alamo Plaza to Flores....	1914	"	"		A. Bet. street car tracks				
"	4	Commerce, Alamo to Soldad St.....	1914	"	"						"
"	5	Travis, Main to Flores.....	1916	"	"						"
Waxahachi.....	1	Various streets.....	1912	½" Sand	Asphalt and sand				Not severe	Yes, greatest where 2" sand cushion used	
Wichita Falls.....	1	" "	1911	Sand	Sand	Some considerably over a yr. after laying	A.		Yes		
"	2	" "	1913	"	Asphalt						No trouble.

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Table II.—Inspection of Wood-Block Pavements.—(Concluded.)

City	Record No.	No. of sq. yds.	Width of roadway	Kind of traffic.	Car tracks.	Depth of blocks.	Depth of concrete base.	Preservative.		Absorption.	Treatment.
								Sp. gr.	Kind of preservative.		
		Total on St	*Feet.*			*Inches.*	*Inches.*			*Lbs. per cu. ft.*	
Dallas	14	12,703	32	Light. Residence St.	Two	3½	5	1.11	Semet Solvay heavy tar mixture.	20½	Steam 6 hrs.; pressure 35 lbs.; vac. 2 hrs., 22 in. Max. oil pressure 115 lbs.
do.	15	5,253	52	Heavy. Business St.	Two	4	6	1.04 to 1.08	Distillate oil specified.	18	
do.	16	514		do.	None	4	6	1.045	Distillate English oil.	20	
do.	17	8,657	50	do.	Two	4	5	1.10 or over	Heavy tar oil.	16	
do.	18	21,491	52	do.	Two	4	6	do.	do.	16	
do.	19	2,957	36		Two	3½	5	1.12 or over	do.	20	
do.	20	15,767	52	Heavy. Business St.	Two	4	6	1.10 or over	do.	16	
do.	21	10,200	52	do.	Two	4	6	do.	do.	16	
Fort Worth	1			do.	Two	3½	5	1.072	London distillate	20.3	Steam 6 hrs ; pressure 20 lbs.; vac. 2 to 4 hrs., 22 in. Max. oil pressure. 110 to 135 lbs..
do.	2			do.	Two	3½	5	1.053: at 38°	English distillate	18.9	Steam 5 hrs.; pressure 20 lbs.; vac. 24 in Maximum oil pressure 125 pounds.
Galveston	1	1,538	48	Heavy.	None	3	4	1.03 to 1.08	Distillate oil.	18	Steam 3 hrs.; pressure 20 lbs.; vac. 2 hrs.
do.	2	1,580	48	Heavy.	None	3½	4	1.03 to 1.08	Distillate of coal gas or coke oven tar.	18	do.
do.	3	3,231	48	Heavy.	None	3	4	do.	do.	18	do.
do.	4	1,702	38	Moderate.	None	3	4	do.	do.	18	do.
do.	5	1,923	38	do.	None	3	4	do.	do.	18	do.
do.	6	1,333	38	Heavy.	None	3	4	do.	do.	18	do.
do.	7	1,917	38	Heavy.	None	3	4	do.	do.	18	do.
do.	8	6,134	48	Heavy.	None	3	4	do.	do.	18	do.
Greenville	1			Light. Business and residence Sts.	One			1.14	Heavy tar oil.	20	
Houston	1	4,386	45	Heavy. Residence St.	Two	3	6	1.05	Distillate.	20	
do.	2	7,684	46	Light. Residence St.	One	3	6	1.05	do.	14	
Longview	1	16,000		Light. Business St.	None	3	5	1.034 to 1.05	London distillate.	20	Steam 3 hrs.; pressure 25 lbs.; vac. 1½ hrs. 22 in. Max. oil pressure 105 to 110 lbs.
San Angelo	1	42,000	70	Light. Business Sts.	One	3	5	1.10 or over	Heavy tar oil.	20	
San Antonio	1	2,949	71	Heavy.	One	3½	5	1.03 to 1.08	English distillate.	16	Steam 6 hrs.; pressure 22 lbs.
do.	2	15,246	75	Heavy.	Two	3½	5	do.	do.	16	Final vac. 2 hrs , 22 to 25 in.
do.	3	5,428	42	Heavy.	Two	3½	5	do.	do.	16	do.
do.	4	4,933	40	Heavy.	Two	3½	5	do.	do.	16	do.
do.	5	647	35	Heavy.	None	3½	5	do.	do.	16	do.
Waxahachi	1	8,000	60	Light.	None	3½	5	1.10 or over	Heavy tar oil.	20	do.
Wichita Falls	1					3	5	1.12	do.		
do.	2								Light distillate oil.		

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Table II.—Inspection of Wood-Block Pavements.

City	Record No.	No. of sq. yds.	Width of roadw'y	Kind of traffic.	Car tracks.	Depth of blocks.	Depth of concrete base.	Preservative. Sp. gr.	Preservative. Kind of preservative.	Absorption.	Treatment.
		Total on St.	*Feet*			*Inches.*	*Inches.*			*Lbs. per cu. ft.*	
Mobile	1	4,793	26	Light. Residence St.	None	4	4		Oil specified to equal "Kreodone"	18	Steam and vacuum.
do.	2	7,575	24	do.	None	4	4		do.	18	do.
do.	3	655	24	do.	None	4	4		do.	18	do.
Shreveport	1	1,600	37	Moderate. Business St.		4	18		Heavy tar and creosote oil		
do.	2	14,000	36	Light. Residence St.	Two	3			do.	20	
do.	3	5,300	36	do.		3			do.	20	
do.	4		36	do.		3			do.	20	
do.	5			Moderate. Business St.		3			do.	20	
do.	6			do.		3			do.	20	
do.	7			do.		3			do.	20	
do.	8			do.					do.	20	
Austin	1			Light. Business St.	None	3	5	1.10 or over	Heavy tar oil	20	
do.	2	3,752		Light. Residence St.	Between rails				do.	16	
do.	3			Light. Business St.		3	5	1.10 or over	do.	20	
do.	4			Heavy. Business St.							
Beaumont	1	19,120		Light. Residence St.	None				Heavy tar oil	22½	
do.	2			Fairly heavy. Business St.		3½			do.	22½	
do.	3							1.03—1.08		18	
Dallas	1	23,800	44	Moderate.		4		1.055	English distillate	18.2	Steam 4 hours; pressure 25 lbs.
do.	2	15,224	30	Light. Residence St.	None	3½	5	1.07	English distillate with 15% tar.	20.1	Steam 6 hrs.; pressure 25 lbs.; vacuum 4 hrs., 21 in. Max. oil pressure 100 to 135 lbs.
do.	3	14,631	30	do.	None	3½	5	1.07	do.	18.1 to 18.2	Steam 4 hrs.; pressure 20 lbs.; vacuum 2 hrs., 21 inches.
do.	4	11,029	30	do.	None	3½	5	1.068	English distillate	do.	Steam 4 hrs.; pressure 20 lbs.; vacuum 2 hrs., 21 inches.
do.	5	4,882	36	do.	Two	4	6	1.067	English distillate with 15% tar	18.5	
do.	6	1,019	36	do.	Two	4	5	1.06 to 1.10	do.	18	
do.	7	23,376	30	do.	None	3	5	1.11 or over	Heavy tar mixture	20.5	Steam 4 hrs.; 15 lbs. pres.; vac. 2 hrs., 22 ins.; max. oil pres. 180 lbs.
do.	8	8,623	43	Heavy. Business St.	None	3½	6	1.08	English distillate with 15% tar.	18	
do.	9	6,641	40	Moderate. Business St.	None	4	6	1.12 or over	Heavy tar oil	20.2 to 20.5	Steam 6 hrs.; pres. 20 lbs.; vac. 22 inches; max. oil pressure 100 lbs.
do.	10	20,741	36	Light. Residence St.	Two	3½	5	1.08	Distillate oil with 15% tar	19	Steam 3 hours.
do.	11	7,646	32	Moderate. Business St.	None	3½	6	1.08	do.	19 to 20	do.
do.	12	4,166	50	Light.	Two	4	5	1.11 or over	Heavy tar mixture	20	
do.	13	10,956	32	Light. Residence St.	None	3½	5	1.11	Semet Solvay heavy tar mixture	20 to 21	Steam 4 hrs.; pressure 35 lbs.; vac. 2 hrs., 22½ in. Max. oil pres. 105 to 110 lbs.

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MR. C. H. TEESDALE: These data were collected from the files of city engineers and from the files of inspectors and inspection agencies that inspected many of these pavements, and in some cases from the files of treating plants and also from visual inspection of the pavements.

The troubles experienced with these pavements were not due to the use of a heavy tar oil, or to the use of a distillate oil, but to improper construction. Most of the trouble was from expansion, and was caused by the use of a sand filler rather than a bituminous filler. In many cases the selfsame blocks which had given unlimited expansion troubles gave no further trouble after being relaid with bituminous filler. There were some cases of poorly-treated blocks which gave no trouble when they were laid on mortar cushion with asphalt filler. Are there any questions which you would like to ask?

MR. A. E. LARKIN: I would like to ask if Mr. Teesdale would like to have the members of the Association believe that the matter of treatment and the matter of preservative used are of so little importance, as they might be led to believe by his remark?

MR. C. H. TEESDALE: The pavements studied were in almost every case less than 6 years old. The troubles were not due to the question of whether they were well treated or poorly treated. I found only one case of decayed blocks in all the pavements which I saw. The question of treatment is an entirely different one, and had very little to do with the troubles which developed in the pavements reported in this paper.

MR. A. E. LARKIN: No one could help drawing the conclusion from your report that the matter of treatment is secondary and the question of a preservative is secondary. Do you think that impression should be allowed to prevail?

MR. C. H. TEESDALE: It is not intended to give that impression. When you read that report you will find that its not given.

DR. HERMANN von SCHRENK: I gather from your report that the troubles in the Texas cities which you investigated, which by many have been ascribed to the fact that they use heavy coal-tar oils instead of distillate oils, you found that the use of heavy coal-tar oils made very little difference as compared with the distillate oils, and that they had trouble in both cases.

MR. C. H. TEESDALE: That is correct.

DR. HERMANN von SCHRENK: In other words, the troubles cannot be ascribed to the oils?

MR. C. H. TEESDALE: The troubles cannot be ascribed to the oils. They had trouble with the distillate oils where the construction was not right, and they also had trouble with the heavy tar oil.

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MR. A. E. LARKIN: Of course, a 6-year-old pavement is not particularly interesting to a manufacturer or consumer of creosoted wood blocks. We all think that the creosoted wood-block pavement is not a 6-year pavement, or a pavement that is comparable at all to any other types of pavement from the standpoint of its life in service. It is just a question if the point has been made prominent enough in your report that it is only a 6-year-old pavement that you are considering and that this is simply a preliminary progress report, as a matter of fact.

MR. C. H. TEESDALE: I would not call it a preliminary progress report. In a number of cases the pavements have entirely disintegrated within 4 years.

MR. A. E. LARKIN: It seems as though the question of preservative ought to be gone into very carefully. I realize that you are concentrating upon the matter of construction. Of course, you can take the best treated block that can be made and place it improperly and have a failure. You are discussing 6-year-old pavements and eliminating the question of the preservative. If you were discussing 15 or 20-year-old pavements, of course the question of preservative would no doubt play a very much larger part in your report.

MR. C. H. TEESDALE: At the time I made this study I also made a study of pavements which were 10 years old, or more. I have been unable to compile the results of that portion of the study, but there, just as you say, the question of preservatives is the most vital one. In a pavement which is from 4 to 6 years old the question of the quality of the preservative has not had time to enter into the calculation. It is a question more largely of construction. The statement is made in the report, too, that the blocks were in almost every case thoroughly treated.

MR. A. E. LARKIN: If that is made plain in the report, as it has been made plain in the discussion, then it would be all right, but it is not anything like as prominent as it should be in your report, and if the discussion and your statement mean that the 10-year-old pavement would depend to a very much larger extent on the preservatives used, it would place your report in shape so that it could be more readily understood.

MR. C. H. TEESDALE: I might just attempt to read a table which is contained in this report which gives a kind of summary of the thing. The title of the table is "Summary of Condition of Pavements Inspected."

MR. WALTER BUEHLER: Mr. Teesdale's conclusions relative

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to the influence of the quality of the oil has on expansion have been drawn from a study of failures.

Minneapolis affords a very interesting case where exactly the same conclusion can be drawn from a study of an absolute success. Minneapolis has pavements from 1 year to 15 years old. There are probably 80 miles of these pavements. They have been treated in the last 15 years with several kinds of oil.

There are some very light distillate oil treatments, there are tar mixtures of different characters of tar and also different percentages of tar. It does not seem to have made very much difference in Minneapolis, taking into consideration the character of the construction, which was all bituminous filler, what kind of oil was used. They have had a uniformity of success with all pavements.

THE PRESIDENT: For the information of everybody, Mr. Teesdale said 61 pavements are reported. When you get his report, you will find all the facts in a tabulated statement. If you are not satisfied with Mr. Teesdale's conclusions you can draw your own from the details he has given.

Next on the program is a paper by Miss Mabel Thorne on "The Relation Between Average Life of Ties and Percentage of Renewals." Renewals." This paper will be read by Mr. Hicks.

RELATION BETWEEN AVERAGE LIFE OF TIES AND PERCENTAGE OF RENEWALS.

By Mabel E. Thorne,

Forest Products Laboratory, Madison, Wis.

In cooperation with the railroads the Forest Products Laboratory has for several years collected records of tie replacements and removals. These records show a wide variation in the life of individual ties, even when laid under exactly similar conditions, so that replacement of a group of ties will extend over a considerable time, beginning with a few renewals, the number gradually increasing to the maximum and then gradually decreasing until the last tie is replaced. In spite of this variation in the life of the individual ties, records for various groups show a remarkable similarity between the percentage of removals at proportionate intervals of the life of the group. For example, if one group had an average life of 6 years and 10% had been renewed at the end of 4 years, it would be found that for a group with an average life of 9 years 10% would be renewed in 6 years.

This similarity in renewals makes it possible to combine all durability records in an attempt to show the general law or relation of tie

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TABLE 1.

RECORDS USED IN DETERMINATION OF THE CURVE REPRESENTING TIE RENEWALS IN RELATION TO AVERAGE LIFE.

Treatment	Record No.	No. of Ties in Group	Species	No. of Inspections Recorded	Average Life	Location
Untreated	1	30	Ash	5	4.8	West of Mississippi River
Untreated	2	48	Birch	4	3.7	West of Mississippi River
Untreated	3	30	Birch	4	3.5	West of Mississippi River
Untreated	4	48	Tupelo gum	5	4.0	West of Mississippi River
Untreated	5	30	Hard maple	6	4.7	West of Mississippi River
Untreated	6	29	Soft maple	5	4.1	West of Mississippi River
Untreated	7	47	Tamarack	6	4.9	West of Mississippi River
Untreated	8	89	Birch	5	2.9	East of Mississippi River
Untreated	9	88	Tupelo gum	6	2.9	East of Mississippi River
Untreated	10	2168	Tamarack, pine, spruce and fir	6	7.4	Montana
Untreated	11	424	Chestnut oak	6	7.7	Indiana
Untreated	12	203	Western hemlock	5	7.3	Washington
Untreated	13	570	Douglas fir	5	7.6	Montana
Untreated	14	568	Western larch	5	7.4	Montana
Untreated	15	551	Western larch	6	7.3	Montana
Untreated	16	571	Douglas fir	5	7.7	Montana
Untreated	17	170	Hemlock	6	6.7	Wisconsin
Untreated	18	132	Tamarack	5	6.6	Wisconsin
Untreated	19	1000	Pine	13	4.4	Texas
Untreated	20	1003	Cypress	7	2.5	Texas
Untreated	21	1644	Pine	14	7.5	Texas
Untreated	22	41	Red gum	4	2.0	Texas
Untreated	23	300	White oak	12	8.6	Virginia
Zinc chloride	24	1000	Pine	13	5.8	Texas
Zinc chloride	25	1694	Pine	16	15.5	Texas
Vulcanized	26	342	Pine	11	2.7	Virginia
Vulcanized	27	250	Gum	12	3.9	Virginia
Zinc chloride	28	2916	Pine, tamarack and fir	10	8.5	Idaho
Hassellman	29	100	Pine	5	4.7	Texas
Zinc chloride	30	4786	Hemlock	9	10.1	Central states
Zinc chloride	31	1000	Hemlock	7	11.6	Central states
Zinc chloride	32	275	Hemlock	6	8.3	Central states
Zinc chloride	33	200	Hemlock	9	10.9	Central states
Zinc chloride	34	5909	Hemlock	12	10.1	Central states
Zinc chloride	35	438	Hemlock	9	9.7	Central states
Zinc chloride	36	1048	Hemlock	10	9.7	Central states
Zinc chloride	37	521	Hemlock	6	8.9	Central states
Zinc chloride	38	135	Hemlock	8	10.6	Central states
Zinc chloride	39	9937	Beech	12	11.1	Central states
Zinc chloride	40	200	Tamarack	5	8.8	Central states
Untreated	41	200	White oak	7	10.2	Central states
Untreated	42	200	White oak	6	9.5	Central states
Untreated	43	2001	Cedar	9	17.2	Iowa

Total number untreated ties.....12,185 Total number both treated and untreated..... 42,936
Total number treated ties.....30,751

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renewals in any group of ties, to the life of the group. If this can be done the curve showing the relation would find its greatest value in estimating the average life of a group of ties long before all the ties in the group have been removed. The number of renewals to be expected in any subsequent year could be estimated after average life had been determined. The curve could also be used to check up the practice of various railroads, or various divisions of the same road. It might also serve as a basis for a table of depreciation values.

Several difficulties were encountered in combining records and so determining this general curve representing tie renewals.

(a) There are few completed authentic records of groups of ties.

(b) Inspections for many groups were made both infrequently and irregularly. This increases the roughness of plotted data.

(c) Removals are recorded as "removed to date, since last inspection." While these figures may be absolutely correct, they furnish no clue as to the rates of renewals at points in the interval specified.

(d) The length of life of ties of different records varies considerably, hence records cannot be plotted on actual time as a base.

As to the first difficulty mentioned, it is obviously impossible to make up for the lack of records. There are, however, reliable records of 42,000 ties at hand. The scheme devised for combining records will allow the inclusion of additional data as it becomes available and so make possible the determination of the renewal curve with greater accuracy.

The infrequency and irregularity of inspections can be obviated only by excluding those records where such defects are so pronounced as to render the records untrustworthy. No records with less than four inspections were used; it was thought that with fewer inspections the roughness of the data would be so marked as not to fairly represent the rate of renewals. Inasmuch as the records are given in the summation form for various intervals, it was decided to determine the curve in the same form.

Since the numbers of renewals in the different groups cannot be plotted on actual time, the average life was used as the base. The average life was first determined for each group and then the percentage of average life at which inspections were made. The following record is representative:

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Number ties set, 521. Locality, Central States. Average life, 8.9. Preservative, Zinc Chloride. Species, hemlock.

Years—Service	Percent Removed	Percent of Average Life
6	0	67
7	20	29
8	36	90
9	55	101
10	98	112
15	100	169

First, the percentage renewals for each group were plotted against the percentage of average life for the corresponding group. Table 1 lists the records used. A weighted average was then taken of all points at each 5% interval of time, and these weighted averages were taken as points on the curve representing the law of renewals (Fig. 1).

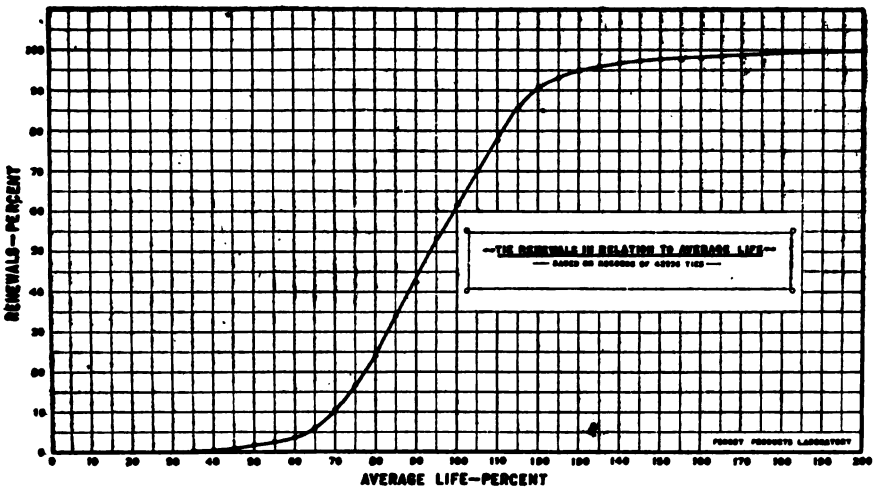

Fig 1.

It may be noted that up to 30% of average life, in general, no ties are removed; that at the time of average life 60% of the ties have been removed; that at one and two-thirds times the average life practically all are out.

As new records become available they will be included in the data on which the curve is based.

Table 2 gives the "renewals to date" at intervals of 5% for treated and untreated ties, taken separately and together, as determined from 43 records. Further study of the subject may reveal dissimilarities in form of curves for untreated and variously treated ties, but the results so far obtained seem to offer no valid objection to their representation by the same curve.

NOTE: Electrotypes of diagrams supplied by the "Railway Review."

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Although the average life of treated ties may be much greater than that of untreated ties of the same species, the results so far indicate that the renewals in proportion to the average life are the same in both cases. It is possible that, as more records are added, difference between the curves determined by treated and untreated ties will become more pronounced. In this case it will, of course, be necessary to have more than the one standardized curve. A careful study of the available data leads strongly to the belief, however, that the differences will be less pronounced after the inclusion of more data. These differences are represented graphically in Fig. 2. It is generally

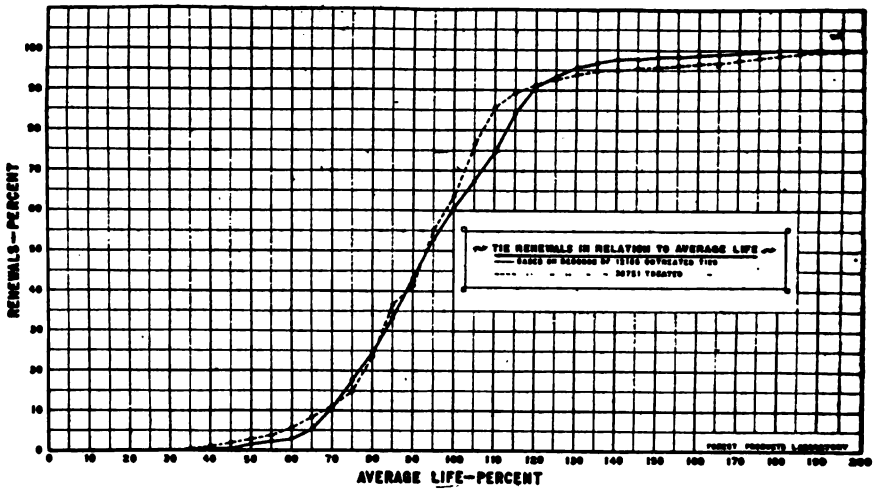

Fig. 2.

conceded that of treated ties the greater percentage of renewals is due to mechanical failure and of untreated ties by far the greater part is due to decay. Whether or not these factors affect rates of renewals in different ways is a question on which no authoritative information is available. It seems likely that "practice" accounts more largely for the variability of these records than any other single factor.

It is very probable that the results obtained from more complete data, if plotted in the standard form for frequency distributions, rather than in the summation form, will follow one of the seven standard forms of Pearson's curves.* In that case it may be possible to obtain

*Discussions of these curves and their applications may be found in: Davenport, C. B.; Statistical Methods; Elderton, W. Palin; Frequency Curves and Correlation. Yule, G. Udney; An Introduction to the Theory of Statistics.

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TABLE II.

TIES REMOVED AT INTERVALS OF 5% OF AVERAGE LIFE AS DETERMINED BY A COMIBNATION OF 43 DIFFERENT RECORDS AND REPRESENTING 42,936 TIES.

Percent of average life	(a) Untreated	(b) Treated	(c) All ties
1—25	0.	0.	0.
30	0.	0.	0.
35	0.4	0.1	0.2
40	1.2	0.5	0.7
45	2.0	0.6	1.0
50	2.9	1.6	2.0
55	3.8	2.2	2.6
60	5.7	2.8	3.6
65	8.3	5.2	6.1
70	11.1	10.5	10.6
75	15.0	17.6	16.8
80	23.6	24.3	24.1
85	36.6	33.1	34.1
90	41.3	43.0	42.5
95	55.2	52.9	53.5
100	63.6	60.8	61.6
105	76.6	67.4	70.0
110	85.7	74.6	77.8
115	98.4	84.1	85.6
120	91.4	90.9	91.0
125	92.8	93.4	93.2
130	93.9	95.9	95.0
135	94.7	96.6	96.0
140	94.9	97.4	96.7
145	95.3	97.9	97.2
150	95.8	98.2	97.5
155	96.1	98.3	98.3
160	96.6	98.6	98.0
165	96.9	98.9	98.3
170	97.4	99.1	98.6
175	98.0	99.5	99.1
180	98.6	99.9	99.5
185	99.0	99.9	99.7
190	99.3	99.9	99.8
195	99.6	99.9	99.8
200	99.7	99.9	99.9

(a) Based on 26 records comprising 12,185 ties.
(b) Based on 17 records comprising 30,751 ties.
(c) Based on 43 records comprising 42,936 ties.

the theoretical curve or general law governing tie renewals, which would manifestly be of more value than the observational curve we have so far deduced. The normal curve of error (Pearson's type 7) has been applied to the data so far obtained and the results plotted in the summation form in Fig. 3 for the purposes of comparison. It is evidently a very close fit. The normal curve, or the equation of the normal curve, as applied to the above data is:

$$Y = \frac{17.6}{(2.718)^{\frac{X^2}{10.2692}}}$$

Verbally expressed the formula is Y= 17.6 divided by 2.718 raised to the power represented by X^2 divided by 10.2692.

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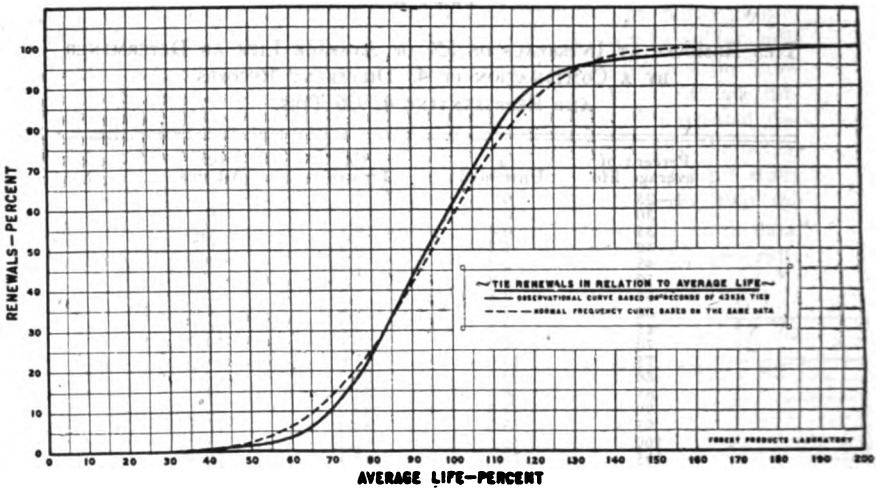

Fig. 3.

THE PRESIDENT: I am afraid the illustrations referred to are so small that they do not give the Association a chance to comment on them with satisfaction. We will therefore proceed to the next paper, one by Dr. von Schrenk on "The Effect of the War on the Supply of Timber of Various Sizes" (applause).

DR. HERMANN von SCHRENK: Mr. President and Gentlemen: This subject, concerning which I was asked to say a few words, is very much like the creosote oil situation. As you all know, very shortly after our entrance into the war last summer, plans were formulated by the various Government bureaus for the Government necessities, and many of us became immediately aware of the tremendous activity which started in Washington looking towards the possible supply for the various Government requirements.

At first there was a great deal of fear expressed by the users of lumber that we would practically have to stop operations owing to this enormous Government demand. Unfortunately, I have not brought with me any of the actual figures showing what the response of the lumber industry of the country was to that sudden demand. I want to recall to you, however, the fact that from the beginning of July until hardly the end of September this country witnessed a development in the utilization of lumber such as none of us had ever dreamed of. Some of the cantonment structures were ordered and built practically over night.

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I was present in Washington one day early this summer when a War Department officer came into the office of the Secretary of the Emergency Bureau of the Southern Pine Association and handed him the bill of materials for one of the cantonment structures out here in the central west and asked him when he could have the material on the ground. He asked him when he wanted it, and he said he wanted it inside of 14 days. The Emergency Bureau at New Orleans was communicated with by long distance telephone, and they, in turn, called up the different sawmills located in that particular district, and every foot of lumber of that cantonment was on the ground before the end of the fifth day.

At the time the discussion was being had in Washington the pine trees were growing in the forest, and it meant logging operations, it meant cutting operations in the mills, it meant shipping operations to the particular cantonment, and I might add furthermore that it was hardly two weeks after the lumber had arrived that the first troops were entering into those buildings.

Some of you who have seen moving picture films showing the way in which that work was done I am sure will be able to appreciate the magnitude of what was accomplished between the Quartermaster Corps and the sawmills of the South and of the West and the railroads, not to leave out the contractor who was responsible for that construction.

During that period necessarily a very considerable shortage occurred in the smaller sizes, particularly of materials involving building lumber, but that period very quickly passed, and since that time the requirements of the Government, while they have been very large, have been fairly normal so far as the production is concerned.

Shortly after the development of the cantonment work, however, came the demand for the shipbuilding program, and it was very soon realized that the available stocks on hand were entirely insufficient to meet the demand. Hurried conferences were called on the part of the Emergency Fleet Corporation and the various organizations handling the manufacture and distribution of lumber, as well as the bureaus organized under the Government auspices for the transportation of the material, and it became evident very shortly that a very rigid policy would have to be adopted with respect to utilizing every available man, every available mill from the Atlantic to the Pacific if we were to live up to the promises which had been made to the people of this country as well as to the Allies of our Government at the present time. That resulted in the issuance of embargoes on the shipment of all sizes of lumber capable of being utilized in the shipbuilding program. Naturally those sizes were of the larger timbers, and to make a long

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story short practically every timber-operating mill of the pine group, as well as of the Douglas fir group, is acting under the direct instructions of various governmental bureaus at the present time. They are working night and day to get the necessary timbers for that construction.

Many of us, I doubt, realize the magnitude of the job which the Government has undertaken. We had only a comparatively small number of shipyards at the time, and most of those were devoted to the construction of steel ships. Immediately, however, with the organization of the work, the shipyards sprang up on the Atlantic, the Gulf and the Pacific Coast. The last information I had from the southern field was that there were some 85 ships being built on the Gulf coast alone and the amount of material necessary for that, all of it more or less of special manufacture, is, of course, enormous. A few weeks ago when I received the request from your Committee to say a few words about this matter, in order to be perfectly sure I addressed a letter of inquiry to the Southern Pine Association asking what message I could bring to the wood-preservers as to what they might expect in the immediate future as to lumber shipments in connection with the wood-preserving field, and with your permission I simply want to read a condensed statement which I asked them to prepare.

(The speaker here read a statement from the Southern Pine Association indicating that there would be an abundant supply of the usual sizes of lumber used in the wood-preserving industry, except for larger sizes, most of which will be needed in the shipbuilding industry. Where cases of urgent necessity arise, relief can possibly be obtained by application to the Lumber Committee in Washington, in which a full statement should be given as to the needs and reason for the urgent condition.)

I just returned this morning from a trip to the northwest Pacific Coast, and while in Seattle last week I had a conference with a number of the larger operators as well as with the Secretary of the West Coast Lumbermen's Association, and he practically confirms the statement made by the Secretary-Manager of the Southern Pine Association, namely, that the west coast mills are in a position to supply practically any requirement which may be made in the way of ordinary sized lumber, except the 12 by 12 timbers and larger, and even these, as in the case of the Southern Pine Association, will be released upon proper representation to the Director of Lumber in Washington, as to the urgency or need of any particular size you may have to have in actual operations.

I do not think that this is the time for any of us to take any attitude with regard to the utilization of material, except one which

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will say, first of all, that the needs of our Government come first, last, and all the time, and that there need, however, on that account be no discouragement on behalf of the uses such as most of us are interested in, because the manufacturers of lumber have certainly shown their ability, as well as their desire, and capacity, to meet the more than unusual demand which has been put on them at this time, and about the only thing that we should do is to cooperate with them to the fullest possible extent, namely, to so clearly and explicitly specify the need and necessity of any particular case, which, of course, it will always be easy to do where there is such a necessity, and to thereby aid the Government in properly distributing the needed material.

This is the time above all when we want to avoid any kind of hysteria. We do not want to have people getting the impression that the situation is by any means as serious as some people have given out. In other words, our manufacturing and distributing agencies, while they may for the time be more or less in a reserved condition will, nevertheless, so far as I have been able to size up the situation, be fully able to meet the situation which confronts us at the present time.

The smaller sizes of building material such as used by the railroads, even the ordinary sized bridge materials, paving blocks, lumber and material of the kind that is usually used by wood-preservers, is available in ample quantity, and the only difficulty which will probably be found by most of us at the present time is the difficulty of getting it moved. In other words, the car supply question enters into it very seriously, and even that is a matter which will probably regulate itself upon proper presentation to the proper authorities. Anyone in doubt at all as to the proper procedure in such case will obtain the very fullest information by writing clearly and accurately the kind of need he has to the Director of Lumber of the National Council of Defense at Washington, or to the Secretary-Manager of the Southern Pine Association at New Orleans, or to the Secretary of the West Coast Lumbermen's Association at Seattle.

During the past two or three weeks while constantly on the trains in various parts of the country I was impressed with the speed, the comparative speed, under more or less abnormal traffic conditions, with which requirements are actually being met. There are doubtless numerous causes for complaint. Those I need hardly say are due to local conditions rather than to national conditions.

Now, while I am on my feet and while this is not exactly on the program I want to say just one word about the role of the wood-preservers in connection with this difficulty that we are having at the present time. It seems to me that now, if ever, the members of this organization can show what they are made of, and this organization

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can show what it is made of, in connection with this lumber question. Now, if ever, is the time to show the public whom we are dealing with collectively, as well as individually, the one great reason for the existence of the American Wood-Preservers' Association. If there ever was a time in the history of the United States when we should be indicating the desirability and methods for using properly-treated wood, now is the time. If we show the public the ultimate service of treated wood, no matter what process is used or how it is treated, it will mean just that much more national efficiency, and while it may be necessary oftentimes to use untreated material, nevertheless we ought not to quibble about giving the user high-priced or longest-service kind of treatment, particularly in view of the scarcity of creosote oil. With this view of the problem in its broadest aspects, when the present difficulty is over the lesson which we will learn now in the conservation of material will not be so soon forgotten by the public, and we of all people interested in the lumber end of the game can do a great deal towards bringing about a better realization of what treated lumber actually stands for and why it should be used by all.

THE PRESIDENT: I am sure everybody is glad to get this more cheering message about one class of material which is used in wood-preserving.

We will now have a paper on "Volume-Temperature Correction for Creosote Oil Measurements." This paper will be read by Mr. Church, but was written jointly by Mr. S. R. Church and Mr. J. M. Weiss.

VOLUME—TEMPERATURE CORRECTION FOR CREOSOTE OIL MEASUREMENTS.

By S. R. Church and John Morris Weiss.

In the measurement of liquid materials it is necessary, where anything like accurate determinations are needed, to correct for temperature using some previously determined factor based on volume change per degree of temperature for the particular kind of oil. In the case of oils that are entirely liquid throughout the ordinary range of atmospheric temperature and are not so viscous as to require the application of heat to facilitate handling, the temperature variation of the oil is substantially in accord with atmospheric variations, and the volume change is, for the most purposes, negligible. But in the case of coal-tar creosote oil, which contains a relatively large proportion of substances, such as naphthalene and anthracene, which are normally solids at atmospheric temperature and which are in complete solution only

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at temperatures considerably above atmospheric, the volume-correction factor becomes a matter of considerable commercial importance.

The factor now in most common use for making volume correction is often stated as being .00044 for each 1°F., or .0008 for each 1°C. This has been commonly used as a volume correction equivalent to 1% for each 22.5°F. of observed temperature above or below the desired temperature.

So far as we have learned, this factor was determined by experiments made under the supervision of the late Dr. H. W. Jayne, of the laboratory of the Chemical Department of The Barrett Company, at Philadelphia, about 1904. In all probability the earliest publication of the factor was in Bulletin No. 65 of the American Railway Engineering and Maintenance of Way Association, July, 1905, where it is given as a correction for use in determining the specific gravity of oil.

Various inaccuracies have accompanied the use of the correction factor. In the first place, the correction factor for specific gravity determination is not necessarily the same as the correction factor for volume, because the latter, although based on density is shown to be substantially constant throughout the range of temperature in which we are interested, and the former is not. This will be referred to more explicitly in dealing with the experimental data.

A common inaccuracy in applying the volume temperature correction is in correcting on the expanded volume instead of on the volume at the standard temperature. For example, assuming the standard temperature is 100°F., if the oil is measured at 180°F., this would be inaccurately figured as follows, using formula $V=v-v(T-t)b$.

Where V = the volume of oil at the corrected temperature.
v = the volume at the observed temperature (uncorrected).
T = the observed temperature.
t = the corrected temperature.
b = the cubical coefficient of expansion.

Working this out, assuming $v=9900$ gallons, we have $T=180°$; $t=100°$. Solving, we have $V=9552$ gallons. The correct manner of figuring would be as follows, using the formula

$$V=\frac{v}{1+(T-t)\,b}$$

Here we have the same values and solving by the formula; we have $V=9564$, showing an error of 12 gal., due to the incorrect use of the factor.

Although tests made from time to time in our laboratories and by others interested have indicated that the factor above men-

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tioned was reasonably accurate, it was considered highly desirable to have a more comprehensive investigation of the problem for the following reasons: First, the character of oils has changed considerably since the original factor was determined, the average materials now in use being very much heavier than at that time; second, it is evident from difficulties that frequently arise in comparing measurements of oil shipped in tank cars between point of loading and point of unloading that some important disturbing factor is involved, causing a volume change greatly in excess of that indicated by using the ordinary factor.

The latter point in particular needed to be cleared up. One of our plant chemists made a definite statement based on measurements of a tank car and laboratory observations, that a considerable shrinkage occurred in creosote oil, due to crystallizing out of naphthalene. We could find no data in the literature in support of this point, but many practical observations confirmed it. A few months ago a tank car of oil having a rather high naphthalene content was shipped from one of our plants to another. It was loaded at about 150° F., at which temperature the oil was entirely liquid. It was received at a temperature of about 80° F., heated up to about 120° F., and unloaded in a partly liquid and partly solid condition. There was a difference of 500 gals. in the volume corrected to 60° F. between measurements taken at the loading point and those taken at the unloading point.

The whole matter was referred to our Research Laboratory for a thorough investigation to determine, first, a reasonably accurate correction factor for average coal-tar creosote oils as now ordinarily used; throughout the temperature range from 60° F. to 170° F. Second, to determine whether the crystallizing out of solids, as naphthalene, anthracene, etc., interferes with the normal expansion and contraction of the oil.

The coefficient of cubical expansion is usually defined as d in the following expression:

$$V_2 = V_1 (1 + dt)$$

in which V_1 is the smaller volume, V_2 the greater volume, and t = the number of degrees change in temperature.

It is evident that if we determine the volume of a constant mass at two temperatures that we will be able to determine directly from these data the coefficient of expansion for that temperature range. It is also evident that the same information can be obtained by preserving a constant volume and determining the mass of this constant volume at varying temperatures.

There is some confusion in practice between the corrections of density and the coefficient of cubical expansion. The coeffi-

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cient of cubical expansion can be used to apply density or specific gravity corrections, but must be used in a different formula from that usually employed. The factors as ordinarily used for specific gravity correction are merely approximations, but these approximations are usually well within the limit of experimental error of the specific gravity determinations. If over a definite range of temperature, the coefficient of cubical expansion is constant, the correction for density (or specific gravity correction as ordinarily used) is not constant.

In ordinary measurements of oil no account is taken of the expansion of the container, which is usually constructed of steel.

A hollow substance expands as if it were solid, and the changes in every dimension of the hollow within caused by increasing or diminishing temperature is governed by the coefficient of linear expansion of the surrounding material, and the changes in the capacity of this hollow are likewise governed by the coefficient of cubical expansion of the material. Therefore, in measurements of oil we have suggested that it is better to use what we term the apparent coefficient of cubical expansion, which is the difference between the true coefficient of cubical expansion of the oil and the coefficient of cubical expansion of the surrounding metal. The use of this factor can mathematically be shown to be correct for a tank which is full and which overflows with increased temperature. For partially full tanks, such as we have in practice, it does not apply mathematically, but the difference between results obtained by the use of this coefficient and the theoretically correct method (which involves the use of long and complicated formulae) is so small as to be far within the physical accuracy of the measurements.

In our experimental work on creosote oil, two methods were employed. In one method the container was a large iron cylinder closed at the bottom and fitted with a screw cap. This cap was drilled to admit three small corks carrying thermometers and a large one holding a glass tube having an etched mark, inserted, so as to be able to bring the volume of the contained liquid to the same point in successive experiments. The cylinder had a capacity of several gallons, and the three thermometers were in selected positions so as to insure a constant temperature throughout. It was standardized with water, the coefficient of the container obtained and found to check with the given coefficient for iron in Kent's "Pocketbook." Subsequently, the coefficients of oils were determined in this apparatus. It hardly seems necessary here to go into detail as to the method of procedure and the calculations involved, as this would consume entirely too much space.

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The second method comprised determining density at various temperatures by means of a small glass pycnometer, and thoroughly concordant results were obtained by both methods. An elaboration of this work, including further detail on the experimental portion, will be the subject of an article by W J. Huff, who worked out the theoretical considerations relating to the expansion of the container and whose experiments corroborated the earlier work of H. E. Lloyd relating to the shrinkage of naphthalene in its transition from the liquid to the solid phase.

After a considerable amount of preliminary work on various oils, three oils were selected for a thorough test. These oils tested as follows:

Material			No. 1	No. 2	No. 3
			Per Cent.	*Per Cent.*	*Per Cent.*
Specific Gravity at		15.5° C	1.092	1.079	
Distillation total at		170° C	.0	.0	0
A. S. T. M.	" "	200° C	0	0.1	0
D-38-17	" "	210° C	.0	1.6	0
	" "	235° C	.0	23.6	30.3
	" "	270° C	32.0	48.2	58.0
	" "	315° C	57.5	63.1	70.1
	" "	355° C	80.2	82.7	84.8

No. 1 is a high gravity and high boiling liquid creosote oil, containing so little salts that it is liquid throughout the test range. No. 2 is an oil equivalent to the standard of this Association for tie treatment, and shows only small amounts of salts in the lower part of the range. To obtain the effect of a very salty oil, we added 28.5 parts of naphthalene to 71.5 parts of oil No. 1; this (No. 3) contains little more naphthalene than some of the more salty English oils.

An example of the experimental data illustrating the results obtained on oil No. 1 as shown below:

IRON CONTAINER.

First experiment.

Temperature °C.		Coefficient of cubical expansion
Between	78.9 & 61.0	.000765
"	61.0 & 38.3	.000685
"	38.3 & 23.8	.000750
"	23.8 & 15.2	.000701
	Mean	.000725

Second experiment.

Temperature °C.		Coefficient of cubical expansion
Between	79.7 & 60.4	.000727
"	60.4 & 38.0	.000693
"	38.0 & 24.7	.000704
"	24.7 & 14.6	.000662
	Mean	.000692

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PYCNOMETER.

	° Centigrade	Coefficient of cubical expansion
Between	78.4 & 60.8	.000748
"	60.8 & 37.4	.000673
"	37.4 & 24.9	.000691
"	24.9 & 15.3	.000661
	Mean	.000694

The mean of all of the experiments upon this oil gave .000703 as the coefficient of cubical expansion. Similarly oil No. 2 showed an average coefficient of cubical expansion of .000724, and oil No. 3 between 40° and 80° C., .000739. On oil No. 3 below 40°, coefficients varying from .00122 to .00325 per °C were obtained. This difference is due to the shrinkage in volume which takes place on the crystallization of naphthalene. It was further noted that this shrinkage increased with the time the oil was allowed to stand, and had not ceased after a period of 48 hours. It was very evident that no accurate coefficient could be obtained where naphthalene was present and crystallizing, as the extent to which the crystallization had progressed and the amount of naphthalene present would make the coefficient vary above normal down from the point at which crystallization started. We, therefore, concluded that no temperature correction could be accurately made from the liquid to the solid phase or within the latter phase.

Previous experiments had shown that on oils of somewhat lighter boiling point than those used in the above experiments, the coefficient varied from about .00071 to .00075 when these oils were in the liquid phase. Accordingly, we decided to select as the approximate cubical coefficient of expansion of creosote oil the figure of .00073, which would not be appreciably more than + .00003 in error for any particular creosote oil that might be handled. Subtracting from this .00008, which represents the cubical coefficient of expansion of steel, we obtain as a coefficient for use .0007 per °C (.00039 per °F.).

Owing to the very brief time that has elapsed since the conclusion of these experiments we will not attempt to summarize the foregoing data in the form of conclusions. The points of importance to producers and purchasers of creosote oil are, of course, obvious, viz., that the correction factor now in common use is somewhat inaccurate when applied to modern oils. A factor more nearly accurate when taken arbitrarily from the herein described data is .00039 per °F., or .0007 per °C. This factor should be used according to the following formula:

$$V = \frac{v}{1 + (T-t)\,b}$$

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Where V = the volume of oil at the corrected temperature.
v = the volume at the observed temperature (uncorrected).
T = the observed temperature.
t = the corrected temperature.
b = the apparent coefficient.

The other important indication of interest in connection with shipments of creosote oil in tanks is that the oil cannot be accurately measured at temperatures below the point at which it is entirely liquid because of the large and inconstant volume change that takes place when naphthalene is crystallizing or dissolving. This, of course, confirms the generally recommended practice of basing the purchase and use of oil on a temperature of 100°F. rather than a temperature below that point, as most oils are entirely liquid at 100°. In case of oils that arrive in semi-solid conditions—that is, with crystals present in the oil—the oil may be heated in the car until entirely liquid, but this is sometimes difficult, because if the car is loaded with oil well up into the dome, at a substantially uniform temperature throughout, it will be found that on reheating, a part of the oil becomes hot quite rapidly, and before the entire contents of the car is melted a portion of the oil has become heated to such an extent that the oil is likely to overflow from the car.

THE PRESIDENT: Surely everybody here is glad that a hard and fast rule was not drawn against Mr. Church on account of not having submitted his paper in time to print and distribute it. He gave carbon copies to some members of the Association, and if they have had time to consider it and would like to discuss it, we certainly will be glad to hear from them.

DR. A. L. KAMMERER: We have listened with interest and profit to the paper just read by Mr. Church. It occurs to me, considering the work just described was done by a laboratory representing a producing interest, that it would not be uninteresting to the Association to hear from a laboratory representing railroads and other consumers. Unfortunately, I had no opportunity of seeing this paper until yesterday, and, therefore, have not had time to go into the data that have accumulated in our laboratory records on this subject during the past 10 or 12 years.

About eight or nine years ago several of the large railroads decided to mix 20% of refined, low-carbon, coke-oven tar to their creosote oil for tie treatment. We realized that new expansion factors would be required for the measurement of these new mixtures, and at once started laboratory investigations covering quite a number of tars, typical creosote oils, and mixtures of these. Two methods were employed, namely, noting the change in weight of a constant volume with changing temperatures, and noting increase in volume with

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increase of temperature. The latter method was found to be the more satisfactory.

A specially designed dilatometer of 75 c.c. capacity was used, having a long, thin neck, with 1/100 c.c. graduations. These dilatometer bulbs were maintained at various fixed temperatures in a specially designed constant temperature bath. The water bath was heated to and held at various constant temperatures by means of vapors of such liquids as ether, carbon tetrachloride, chloroform, benzol, toluol, xylol, etc. The work developed the fact that the expansion factor decreases with increase of the specific gravity of the oils, also for any individual oil that the factor increases slightly with rise of temperature, particularly for the lower temperatures, this latter effect being no doubt due, as Mr. Church suggests, to the change from solid to liquid phase.

It was found that for a 20-80 coal-tar creosote oil solution, the coefficient of expansion per degree Fahrenheit ranged from .00039 to .00040. The following example is one taken from many:

Sample number.....1639
Specific gravity at 38° C.=1.080
Water ..... =0.0
Distillation:
210° C..... 2.3%
235 .....22.9
270 .....20.3
315 .....13.6
355 .....17.4
Residue.....23.5
Coefficient of expansion per degree F.=0.00039.

It will be noted that the above results are in agreement with those reported in the paper of Messrs. Church and Weiss.

Since making the above determinations for the 20-80 mixture, we have continued to make new determinations at frequent intervals to cover mixtures in other proportions and of tars and oils, the characteristics of which have changed markedly in recent years.

All these data, both from straight distillate oils and coal tar-creosote solutions, develop the fact that the expansion factor decreases with increase of gravity, and in mixtures the resulting factor is proportional to the factors of the individual constituents and to their quantities.

As early as 1905 the Preservatives Committee of the American Railway Engineering Association recognized the fact that when an oil changes from a liquid to a solid condition, or vice versa, considerable volume changes are involved. At that time the Committee recommended the temperature of 100° F. as the standard for taking and reporting the specific gravity of creosote oil. They stated that it was inaccurate to determine the gravity of an oil at a temperature at which the oil was liquid and then attempt by means of a factor to reduce the gravity to 60° F.

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I might also call attention to the reference Mr. Church made to the point that there is still a great deal of confusion and error in applying the reduction factor. While this is true, I do not see why such should be the case, because in 1909 the Tie Committee of the Committee on Preservatives of the A. R. E. A. very specifically covered this point when they recommended that 100° be the standard temperature for measuring the volume of oil. At that time they recommended the then universal factor of .00044 per degree of Fahrenheit, and gave a formula as to how it should be used, emphasizing the fact that 100° should be taken as unity or 100%, and also gave a table of reduction giving specific instructions how it should be used (see 1909 Proceedings, A. R. E. A., pp. 621-623). The A. R. E. A. Proceedings are very accessible to all wood-preservers, and it seems to me there is no excuse for not having this information.

MR. A. E. LARKIN: I think we are very fortunate in having the discussion submitted by Mr. Kammerer. As soon as I read this paper yesterday it occurred to me that inasmuch as Mr. Church refers to the modern oils in several places and confines his discussion largely to the anthracene and napthalene content, that it would be very interesting to learn just what influence the addition of tar to the creosote oil has.

Mr. Kammerer develops the information that this change in the constants that we have used for a long time is perhaps necessitated by the fact that we are now examining mixtures of creosote oil and coal tar instead of straight creosote oil. If possible, I think it would be fine if we could be advised on that particular subject. In case we are examining straight distillate oil, for instance, would it be possible to use the constants that we have always used? Is it necessary to use these new constants in connection with a mixture of coal tar and creosote, and the old ones when a coal-tar creosote oil alone is used?

DR. A. L. KAMMERER: Mr. President, as I said before, I had not much chance to go into the data we have on file, but as I remember it the expansion factor varied with the decrease of gravity irrespective of whether coal tar was added or not. Whether the influence is the same, I cannot say definitely. I think it would be an interesting thing to go into. I would like to ask Mr. Church whether these oil experiments he quotes in his paper were with distillate oils or coal tar-creosote solutions.

MR. S. R. CHURCH: These experiments were made on distillate oils, not on the creosote-coal tar solutions. We did, however, make some subsequent experiments both on creosote-coal tar solution and on coal tar itself. The only reason I did not bring that up was because

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we felt that some further work was desirable before publishing the results.

I may say, however, that we settled one point which was raised in our own laboratory, and that was the question whether the volume correction of a coal tar-creosote solution could be as theoretically calculated from additive proportions, assuming that you have a separate factor for the coal tar and distillate oil. In other words, in some solutions we know that there is a shrinkage in volume. We have proved that there is no shrinkage in volume in the case of the creosote-coal tar solution, and that the mixture is entirely an additvie proposition. There is only a slight difference between the correction factor for a thin light carbon coal tar and that of a heavy distillate oil, so that it is quite likely that a mixture of moderately low gravity creosote oil with coal tar would have about the same correction factor as a higher gravity distillate oil would have. I have not the figures with me or I would be glad to give you the figures we obtained on the tar itself. They are a little lower than these figures, which I have given for the distillate oil. I am particularly gratified to have Dr. Kammerer's confirmative statement on the general accuracy of results that we have reported.

MR. M. K. TRUMBULL: Mr. President, I move that the paper be referred to the Committee on Preservatives.

MR. WILLIAM A. FISHER: I second the motion.

THE PRESIDENT: It is regularly moved and seconded that the paper by Messrs. Church and Weiss be referred to the Committee on Preservatives. All those in favor say "aye," opposed "no." It is so ordered.

We will now hear from the Committee on Preservatives.

REPORT OF COMMITTEE ON PRESERVATIVES.

To the Members of the American Wood-Preservers' Association:

Committee No. 6, on Preservatives, presents herewith a report of its work for 1917, together with its recommendations to the Association.

The instructions of the Executive Committee were received by the Chairman on March 28, 1917, and attempts were made to hold a meeting of the Committee for the purpose of organizing. The members were so busy that this had to be given up, and the Committee was organized and the work initiated by correspondence. This was accomplished satisfactorily, by reason of the fact that our work for this year was largely a continuation of that of last year.

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The following sub-committees were appointed, and the work apportioned among them on very much the same basis as last year.

SUB-COMMITTEE A: S. R. CHURCH, *Chairman*,
A. L. KAMMERER.
SUB-COMMITTEE B: A. L. KAMMERER, *Chairman*,
C. M. TAYLOR.
SUB-COMMITTEE C: C. N. FORREST, *Chairman*,
C. M. TAYLOR.
SUB-COMMITTEE D: S. F. ACREE, *Chairman*,
O. C. STEINMAYER.

During the summer, the Chairman was kept informed of the work being done by the sub-committees through correspondence with their chairmen and by occasional chance meetings with various members of the Committee.

A meeting of the Committee was held in Chicago on October 19, 1917, at which all the members were present, with the exception of Mr. Acree. The other chairmen of sub-committees submitted reports of the work accomplished up to that time, together with outlines of their proposed reports. After some discussion of a few points in the proposed reports, these were approved by all present, and the chairmen were instructed to prepare their final reports accordingly.

Recently the Chairman of Sub-Committee C has reported that it has not been possible for them to work up any additional information of value on the subject of water-gas tar, paving blocks, etc., and that under the circumstances they did not attempt to make a report this year. The Chairmen of Sub-Committees A and B have submitted reports which are made a part of this report in their entirety. As indicated above, these reports have the approval of six members of the whole committee, one member not voting.

REPORT OF SUB-COMMITTEE A.

Sub-Committee A was instructed by the Chairman of Committee No. 6 to investigate and report on the following:

(1) Methods for sampling preservatives (relating to coal-tar preservatives.)
(2) Specifications for creosote corresponding to A. R. E. A. Grades 2 and 3.
(3) Preservatives for use in non-pressure treatments.
(4) Tests of creosote, particularly the float test and the coke test.
(5) Tests for differentiating between coal-tar and water-gas tar oils.

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Sub-Committee A held a meeting in Chicago on September 5, 1917, which was attended by both members, and as a result of this meeting presented a tentative report in written form at the meeting of the whole committee in Chicago on October 19. At this meeting the various subjects assigned to the Sub-Committee were discussed at some length, and in accordance with the foregoing the Sub-Committee now presents its report which is divided into three parts, namely:

(a) This deals with recommendations for revision of standards recommended by the Committee in 1917 and adopted by the Association.
(b) Relating to the adoption of new standards.
(c) Matter presented as reports of progress and information only.

(a) The Sub-Committee recommends the following revisions in the specification for creosote-coal-tar solution for ties and structural timber and coal-tar oil for paving blocks, presented for adoption in 1917, viz., page 308, PROCEEDINGS 1917—Specification for Creosote-Coal-Tar Solution—paragraph 3, which now reads:

> The specific gravity of oil at 38° compared with water at 15.5° C. shall be not less than 1.05 nor more than 1.10.

to be changed to read:

> The specific gravity of the oil at 38° compared with water at 15.5° C. shall be not less than 1.05 nor more than 1.12.

The specification for coal-tar oil for paving blocks (paragraph 3), shall be changed in like manner so that the maximum specific gravity which now reads "1.12" shall be "1.14."

This change is recommended after a very thorough survey of the existing conditions and with knowledge that a very large proportion of oils now being produced, which would meet the other requirements of the specification, would fail to meet the existing requirements as to maximum specific gravity. The Committee would not feel justified in recommending this change were it not for the knowledge it possesses that these oils of high specific gravity, falling above the limits of the old specifications, are being used with satisfactory results at numerous commercial and railroad treating plants.

(b) This section includes subjects 2 and 3 of the matters assigned to this Sub-Committee.

Subject 2. SPECIFICATIONS FOR CREOSOTE CORRESPONDING TO A. R. E. A. GRADES 2 AND 3—The Sub-Committee presents the following specifications:

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Creosote Oil, Grade 2, For Ties and Structural Timber.

The oil shall be a distillate of coal-gas tar or coke-oven tar. It shall comply with the following requirements:

(1) It shall not contain more than 3% of water.
(2) It shall not contain more than 0.5% of matter insoluble in benzol.
(3) The specific gravity of the oil at 38° compared with water at 15.5° C. shall be not less than 1.03.
(4) The distillate, based on water-free oil, shall be within the following limits:

Up to 210° C., not more than 8%.
Up to 235° C., not more than 35%.

(5) The specific gravity of the fraction between 235° C. and 315° C. shall be not less than 1.03 at 38° compared with water at 15.5° C.

The specific gravity of the fraction between 315° C. and 355° C. shall be not less than 1.10 at 38° compared with water at 15.5° C.

(6) The residue above 355°, if it exceeds 5%, shall have a float test of not more than 50 seconds at 70° C.
(7) The oil shall yield not more than 2% coke residue.
(8) The foregoing tests shall be made in accordance with the standard methods of the American Wood-Preservers' Association.

Creosote Oil, Grade 3, For Ties and Structural Timber.

The oil shall be a distillate of coal-gas tar or coke-oven tar. It shall comply with the following requirements:

(1) It shall not contain more than 3% of water.
(2) It shall not contain more than 0.5% of matter insoluble in benzol.
(3) The specific gravity of the oil at 38° compared with water at 15.5° C. shall be not less than 1.03.
(4) The distillate, based on water-free oil, shall be within the following limits:

Up to 210° C., not more than 10%.
Up to 235° C., not more than 40%.

(5) The specific gravity of the fraction between 235° C. and 315° C. shall be not less than 1.03 at 38° compared with water at 15.5° C.

The specific gravity of the fraction between 315° C. and 355° C. shall be not less than 1.10 at 38° compared with water at 15.5° C.

(6) The residue above 355° C., if it exceeds 5%, shall have a float test of not more than 50 seconds at 70° C.
(7) The oil shall yield not more than 2% coke residue.
(8) The foregoing tests shall be made in accordance with the standard methods of the American Wood-Preservers' Association.

In connection with the foregoing the Committee would call attention to the fact that these specifications differ from the standard specification for creosote oil for ties and structural timber (last year) only in connection with the distillation requirements at 210° and 235° exactly

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as stated in the footnote appended to the previous report, page 323, 1917 PROCEEDINGS.

(c) This includes subjects 1, 3, 4 and 5.

Subject 1.—METHODS FOR SAMPLING PRESERVATIVES. The Committee had hoped to present this year a constructive report based on continuation of work done by the joint committee on sampling tank cars for water and creosote oil of the American Railway Engineering Association, American Society for Testing Materials and this Association during 1915 and 1916. It is recognized that while the work of this committee led to some valuable conclusions with respect to sampling tank cars of creosote oil with special reference to the water content, and to the adoption of a sampling device, undoubtedly more accurate in its results than any heretofore used, a great deal of work remains to be done before the entire subject of sampling creosote oil can be considered to be satisfactorily covered. It has been impossible, however, for your Committee to do any work on this problem, and we now feel that the work that remains to be done should be carried on as heretofore by a joint committee representing the three societies.

Subject 3.—PRESERVATIVES FOR USE IN NON-PRESSURE TREATMENTS. Non-pressure treatments embrace all superficial methods of applying wood preservatives, from an application of cold oil with a brush to a process including fixed equipment for immersion in hot and cold creosote. The only preservatives largely used in this field are oils, and these oils are principally of coal-tar origin.

Your Committee has consulted with the Chairman of the Committee on Non-Pressure Treatments, who recommended that three specifications for preservatives be reported corresponding to the three general classes of non-pressure treatment, viz., brushing, dipping and open-tank. After consideration, your Committee does not, however, feel that it will be warranted in so doing. We find that large users of oil for non-pressure treatments, including the United States Government, are substantially in accord in specifying heavy distillate oil such as described by the specification for heavy distillate oil for paving blocks adopted last year by this Association. We, therefore, present for information of those desiring a specification for oil for non-pressure treatment, a modification of that specification, which differs from the original only in requiring that the oil shall be liquid at a much lower temperature and that it permits less distillate in the fractions below 235°.

We desire to state that in the opinion of some authorities familiar with the particular requirements of the open-tank method (more specifically described as the hot and cold-bath method), oils of lower distilling limits than those herewith provided are entirely satisfactory.

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However, in presenting the specification for information, your Committee does not feel warranted in expressing any opinion on this point.

Distillate Oil For Non-Pressure Treatments.

The oil shall be a distillate of coal-gas tar or coke-oven tar. It shall comply with the following requirements.

(1) It shall be thoroughly liquid at 15° C.
(2) It shall not contain more than 0.5% of matter insoluble in benzol.
(3) The specific gravity of the oil at 38°/15.5° C. shall be not less than 1.06.
(4) The distillate, based on water-free oil, shall be within the following limits:

Up to 210° C., not more than 1%.
Up to 235° C., not more than 10%.

(5) The specific gravity of the fraction between 235° C. and 315° C. shall be not less than 1.03 at 38°/15.5° C.
The specific gravity of the fraction between 315° C. and 355° C. shall be not less than 1.10 at 38°/15.5° C.
(6) The residue above 355° C., if it exceeds 10%, shall have a float test of not more than 50 seconds at 70° C.
(7) The oil shall yield not more than 2% coke residue.
(8) The foregoing tests shall be made in accordance with the standard methods of the American Wood-Preservers' Association.

Subject 4.—TESTS OF CREOSOTE, PARTICULARLY THE FLOAT TEST AND THE COKE TEST. Your Committee last year presented a great deal of laboratory data in support of its recommendations concerning these new tests and since last year's report was published a great deal of additional work has been done, particularly in connection with the float test. As a result of this work the Committee does not feel that it desires to make any change in the standards adopted last year. There have been a few oils tested which did not give results exactly in accordance with the specified tests, but these instances have not been sufficiently numerous to warrant any change. The Committee will, therefore, report only progress under this subject.

In response to inquiries as to the meaning of the expression "38°/15.5° C.", the following explanation was published in WOOD-PRESERVING, Vol. IV, No. 3, page 44:

The expression "38°/15.5° C." means specific gravity taken at 38° C. compared with water at 15.5° C. This cannot be determined directly. The specific gravity is first determined at 38° C. compared with water at 38° C., and this determination represents the relation of the weight of a volume of oil at 38° C. to the weight of an equal volume of water at the same temperature. The relation to an equal volume of water at 15.5° C. is obtained by multiplying the former figure by .99385, the density of water at 38° C. compared to water at 15.5° C.

From the foregoing it will be readily seen that it is incorrect to

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calculate the specific gravity at 38°/15.5° C. by dividing the weight of oil taken at 38° C. by the weight of water taken at 15.5° C. An example is given herewith of the correct and incorrect methods of calculating; where the weight of a specific gravity bottle is 23.7531; the weight of the bottle filled with water up to the mark at 15.5° C. is 78.3600; the weight of the bottle plus water at 38° C is 78.1128; the weight of the bottle filled with oil at 38° C. is 80.2755. The correct calculation therefore would be as follows:

$$\text{Specific gravity at } 38/38^\circ\text{ C} = \frac{80.2755-23.7531}{78.1128-23.7531} = 1.0398$$

$$\text{Corrected to } 38^\circ/15.5^\circ\text{ C} = \frac{1.0398 \times .99299\ (\text{D. water } 38^\circ)}{.99913\ (\text{D. water } 15^\circ)} = 1.0335$$

The incorrect method of calculation is as follows:

$$\frac{80.2755-23.7531}{78.3600-23.7531} = 1.0351$$

Your Committee recommends that this explanation be placed in the MANUAL as a footnote under "3. Specific Gravity" (PROCEEDINGS, 1917, page 312).

Subject 5.—TESTS FOR DIFFERENTIATING BETWEEN COAL TAR AND WATER GAS TAR OILS. The Committee regrets to report that owing to unusual conditions existing during the past year, which have made all committee work very difficult to accomplish, nothing whatever has been done on this subject by members of the Committee, neither have we learned of any work on this problem by others.

In conclusion, the Committee wishes to urge that members of the Association or others, who are doing work or know of any work being done on subjects assigned to the Committee, communicate with the Chairman and give the Committee the benefit of their suggestions, criticism, or best of all, constructive information.

REPORT OF SUB-COMMITTEE B.

Sub-Committee B was instructed by the Chairman of Committee No. 6 to investigate and report on the following:

(1) Specifications for zinc chloride.

(2) Methods for sampling zinc chloride.

The Sub-Committee held a meeting in Chicago on October 19, 1917.

1.—SPECIFICATIONS FOR ZINC CHLORIDE. The Sub-Committee recommends that the specification for zinc chloride, presented for adoption in 1917 (see page 326, 1917 PROCEEDINGS), be changed to read as follows:

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The zinc chloride shall be acid-free and shall not contain more than 0.1% iron. Fused or solid zinc chloride shall contain at least 94% chloride of zinc. Concentrated zinc chloride solution shall contain at least 50% chloride of zinc.

2.—SAMPLING FUSED ZINC CHLORIDE. The Sub-Committee has been unable to work out a satisfactory method for obtaining a fair, average sample of the contents of a drum of fused zinc chloride as such for purposes of analysis. This problem is exceedingly difficult on account of the very hard, solid condition of the fused material combined with its very hygroscopic nature. The only practical procedure is to dissolve the whole weighed contents of the drum in a definite quantity of water and then to analyze samples of the resulting solution.

The following outline of the procedure is offered as a suggestion by the Sub-Committee:

Weigh drum, open and dissolve contents in water; weigh empty drum; difference is weight of fused chloride. Weigh resulting solution. If equipment for weighing is not available, the operation should be conducted in a comparatively small, calibrated tank, so that the volume of the resulting solution can be accurately determined. Before measuring the solution in the tank the liquid should be thoroughly agitated, both to equalize the temperature and to cause a homogeneous condition of the solution.

The temperature of the solution is then carefully determined and an accurate reading of the level of the liquid taken. In the case in which it is possible to weigh the solution, it is not necessary to make a temperature reading. However, the solution must be thoroughly agitated before sampling. A sample of the solution is then analyzed for zinc chloride, expressed in per cent. by weight.

In case the solution was made up by weight, the calculation is as follows:

$$\frac{\text{Total wt. solution} \times \%\ \text{zinc chloride by wt.}}{\text{Weight of contents of drum}} \times 100 = \%\ \text{zinc chloride in contents of drum.}$$

In the case in which the solution was made up volumetrically, the specific gravity of the sample at the temperature at which the volume was measured, must be determined. The calculation in this case is as follows:

$$\frac{\text{Total gals. at } t° \times 8.33 \times \text{Sp. Gr. } t°/15.5° \text{ C.} \times \%\ ZnCl_2}{\text{Weight contents of drum}} \times 100 = \%\ \text{zinc chloride in contents of drum; or}$$

$$\frac{\text{Total cu. ft. at } t° \times 62.30 \times \text{Sp. Gr. } t°/15.5° \text{ C.} \times \%\ ZnCl_2}{\text{Weight contents of drum}} \times 100 = \%\ \text{zinc chloride in contents of drum.}$$

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Example:

Net weight of drum	=	1100 lbs.
Volume of solution at 21° C	=	1000 gals.
Sp. Gr. at 21/15.5° C.	=	1.3150
% $ZnCl_2$ by analysis	=	9.50%

$$\frac{1000 \times 8.33 \times 1.315 \times .095}{1100} \times 100 = 94.6\% \text{ zinc chloride.}$$

The Sub-Committee wishes to call attention to an error in the report of last year's Sub-Committee A of Committee No. 1. In presenting for insertion in the MANUAL "Method of Analysis of Zinc Chloride," adopted by the Association in 1912, the Sub-Committee report (page 280, 1917 PROCEEDINGS) reprints the method as it appeared in the 1915 PROCEEDINGS, page 131, which is a slightly modified version of the description of the method as originally adopted by the Association in 1912 (see page 230, 1912 PROCEEDINGS). The only difference between the 1912 and 1915 versions seems to be an improvement in English in the latter. As the point was raised by a member at the last convention, the Sub-Committee feels called on to call attention to the above discrepancy.

CONCLUSIONS.

The Committee recommends the following revisions of the MANUAL:

(1) In the Specification for Creosote-Coal Tar Solution for Ties and Structural Timber, change clause 3 (page 308, PROCEEDINGS 1917) to read as follows:

The specific gravity of the oil at 38° *compared with water at* 15.5° *C. shall be not less than* 1.05 *nor more than* 1.12.

(2) In the Specification for Coal-Tar Oil for Paving Blocks, change clause 3 (page 308, PROCEEDINGS 1917) to read as follows:

The specific gravity of the oil at 38° *compared with water at* 15.5° *C. shall be not less than* 1.07 *nor more than* 1.14.

(3) Under Specification for Zinc Chloride (page 326, PROCEEDINGS 1917) change the whole paragraph to read as follows:

The zinc chloride shall be acid-free and shall not contain more than 0.1% *iron.*

Fused or solid zinc chloride shall contain at least 94% *chloride of zinc. Concentrated zinc chloride solution shall contain at least* 50% *chloride of zinc.*

The Committee suggests the insertion in the MANUAL as a footnote to "3. Specific Gravity" (page 312, PROCEEDINGS 1917) the explanation of the term 38°/15.5° as recommended by the present Sub-Committee A.

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The Committee presents as information:

(1) A specification for Distillate Oil for Non-Pressure Treatments as proposed by the present Sub-Committee A.

(2) A method for sampling fused zinc chloride as proposed by the present Sub-Committee B.

Under its instructions from the Executive Committee, the Committee submits specifications for creosote oil for ties and structural timber corresponding to A. E. R. A. Grades 2 and 3, as proposed by the present Sub-Committee A.

The Committee cannot recommend the adoption of these specifications as standards, for the reason that it believes that they are not necessary, and for the further reason that it feels that the Association should not adopt as standard, specifications for more than one grade of the same material.

The Committee prefers that these two specifications be accepted as information and that there be printed in the MANUAL as a footnote under the Specifications for Creosote Oil, the note at the bottom of page 323, PROCEEDINGS 1917.

RECOMMENDATIONS FOR FUTURE WORK.

The Committee suggests for future work:

(1) Continue the study of methods of sampling zinc chloride and creosote.

(2) Report for information more detailed tests for differentiating between coal-tar oils and water-gas tar oils.

(3) Continue the investigation of wood-preservatives other than zinc chloride and creosote.

(4) Investigate methods for determining the quantity and quality of preservative in treated timber.

E. B. FULKS, *Chairman*,
S. F. ACREE,
S. R. CHURCH,
C. N. FORREST,
A. L. KAMMERER,
O. C. STEINMAYER,
C. M. TAYLOR.

MR. E. B. FULKS: Gentlemen, the report has been printed. I am in somewhat the same condition as Mr. Church. I have been a constant kicker about getting these things out early, but I fell down myself this time. Although it is printed it was not out in time to be mailed to everyone. It has been scattered during the convention, and I

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presume you all have seen it. I will not undertake to read it all, but simply call your attention to some points.

The inference from the signing at the bottom would be that this report was approved by all the members of the Committee, which is not exactly the case. I sent a manuscript of the report to the various members of the Committee, and it was approved by all of them with the exception of Dr. Acree, from whom I have not heard, so I am unaware as to whether he approves or disapproves. I simply do not want to be put in the position of asserting that he approved it. His name probably should not be signed to the report, which is a continuation of the Committee's work last year.

Under Section A of the report of Sub-Committee A I will say that in the distillation of coal tar we must give attention primarily to the production of the creosote oil and the pitch, otherwise we cannot do business. The disposal of the creosote oil, as you all know is a matter of no difficulty, and we are not worried from that side of it. The disposition of pitch is a matter of serious difficulty and requires a great deal of constant effort to keep it cleared out.

Before the war began the great volume of pitch disposed of went for roofing and paving purposes. Those were the comparatively soft grades of pitch, and in making those grades of pitch the creosote oil of ordinary gravities which we are accustomed to use, 1.03, 1.05, 1.06 and around there, were obtained, but since the war began the construction of buildings, particularly of the large type, has very materially diminished, in fact almost ceased, and with it the demand for roofing pitch. At the same time the importation of oil has ceased and the demand for oil has been very great. The output of tar has been larger, although some of it has not been allowed to be distilled. Nevertheless, the output has existed and has been bought under contract by distillers who are compelled to take that tar every day right straight along. They cannot sell the roofing pitch. They must make creosote oil to keep things going, so they are forced to do what they can with this pitch, sell it if possible, and if not take care of it themselves. This has resulted in great quantities of oil having gravities of 1.09 or 1.10, being manufactured. At the same time, on account of the demand for crude materials for explosives, dyes and such things, a great part of the salts, that is particularly napthalene, have been removed so that this oil although having a high gravity and being very high boiling is practically a liquid oil, and is much less salty than the oils we have been accustomed to.

It is readily seen that if to such an oil as that 20% of tar be added, the gravity will be more than 1.10. It was not brought out in the discussion just now of Mr. Church's paper, but, you can figure the

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gravity as almost in proportion to the quantities; that is, as he said, there is no shrinkage of volume, so that if you add a certain amount of tar of a certain gravity to a certain amount of oil of a certain gravity, the resultant gravity will be practically in proportion. Therefore, the Committee proposes that this maximum be allowed to go to 1.12 in one case and 1.14 in the other. These oils are better oils than in the early days we ever expected to get when we were continually talking about the best oils or the heavy high-boiling oils, so that if we stand pat on the specification as it now is and do not allow this slight increase in the gravity we simply keep out of the market a considerable volume of very high-grade material to no advantage to anybody. The Committee recommends then the following revision of the MANUAL. In the specification for creosote-coal tar solution for ties and structural timber change clause 3 (page 308, PROCEEDINGS 1917) to read as follows:

> The specific gravity of the oil at 38° compared with water at 15.5° C. shall be not less than 1.05 nor more than 1.12.

I move the adoption of this recommendation.

DR. A. L. KAMMERER: I second the motion.

THE PRESIDENT: It has been regularly moved and seconded that the specification for creosote-coal tar solution for ties and structural timber be changed to read as follows:

> The specific gravity of the oil at 38° compared with water at 15.5° C. shall be not less than 1.05 nor more than 1.12.

Is there any discussion?

MR. A. E. LARKIN: I have listened with a great deal of interest to the chairman's report. From the standpoint of the manufacturer, he has hit the nail right on the head. No question about that; but how about it when you consider his report from the standpoint of the chairman of the preservative committee of a national organization which should be slow to adopt standards and slow to change them; and how about considering these various points with reference to giving to the industry the correct information with respect to preservatives in general? There is no doubt that Mr. Fulks has developed the exact condition that exists that the manufacturer is loaded up with a material that is hard to get rid of, that there is no market for it, and he thinks here is a good place to dump it. In the long and short of it that is exactly the situation. It is just what we have all been confronted with right through these last several years, and especially this last year.

There are a good many consumers here in the room who if they chose could question this particular paragraph, and I am going to call more especial attention to it. Mr. Fulks says that "this change is recommended after a very thorough survey of the existing condi-

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tions and with knowledge that a very large proportion of oil is now being produced which would meet the other requirements of the specification and would fail to meet the existing requirements as to maximum specific gravity. The Committee would not feel justified in recommending this change were it not for the knowledge it possesses that these oils of high specific gravity, falling above the limits of the old specification, are being used with satisfactory results at numerous commercial and railroad-treating plants."

Now there is the question. I have no doubt that there has been a lot of careful investigating done by this Committee, and yet going through the field as I have there is the practical question in my mind as to whether the consumers will agree that these oils under discussion now are being used with satisfactory results at numerous commercial and railroad-treating plants. It is one thing to take into consideration the condition that confronts us in the industry. It is another thing to come before a national organization of this kind and ask permission to adulterate the preservatives and load them with a material that we know positively will not give the best results. It seems as though there should be a simpler and, perhaps, a better way of handling the situation.

There is no doubt that the condition outlined by the chairman confronts us, but we are justified in changing our specification from year to year with the idea of taking what is handed to us and what is available rather than maintaining a high standard, the standards we have or adopting higher ones. Every report by the Committee outlines the conditions and suggests emergency measures. They tell us the difficulties that confront us, but should they come to us and say, "Adopt this as your standard because we are at war and we have got a lot of material we cannot get rid of. There is no market for this pitch, so take it in your wood-preserving plants and use it and let it stay on the outside of your timber, and let the small amount of creosote oil that comes along with it do the best it can." Those questions really should be considered, and there are a number of gentlemen in the room who have been confronted with great difficulty, because of the grades of preservatives that have been supplied. They may have been supplied because of the general conditions, but would it not be a good thing to hear, if possible, from some of these consumers, and learn whether or not the oils submitted have given satisfactory results? Of course, they have been absorbed rapidly on the market, because we have had to take anything we could get, and we had to keep our mouths shut about it, because it was all that was available and we had to keep our plants in operation, but have they been used satisfactorily, and have they given good results? Those are the points I would like to see discussed.

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THE PRESIDENT: All of us would be glad to hear from anybody who has had the difficulties referred to by Mr. Larkin.

MR. S. R. CHURCH: Mr. President, I think as the gentlemen discuss this point it would be well to have in mind just what they are discussing. I think the remarks of the previous speaker tend to cloud the situation rather than to clarify it. If I understand the remarks correctly, he implies that it was the intention of the Committee in asking that the specific gravity of the oil be raised, to permit additional quantities of tar to be put in the oil. I think it is perfectly clear to anyone who has studied the Committee's report that such was not the case. The fact of the matter is that the specification distinctly provides for the limit of tar which can be added and nothing is further from the Committee's mind than the idea of opening up the specification in that particular.

MR. C. H. TEESDALE: Mr. President, as I understand it this change in the specification is prompted by the present unusual conditions created by the war and that after the war is over the condition will probably return to normal. I am wondering if it is not rather unwise to suggest changes in the specifications which are caused by unusual conditions, and whether it would not be better to consider permitting such a change in the specification, possibly for the duration of the war, but not to suggest the change for our MANUAL, which should be a permanent thing and not subject to fluctuating changes in the industry.

THE PRESIDENT: Any other discussion? In recommending the change in the MANUAL the Committee undoubtedly gave consideration to all the points involved, think the MANUAL should be changed, and do not have in mind the changing of it again in a couple of years.

DR. HERMANN von SCHRENK: Mr. President, about a year or two ago we were confronted with this condition of these heavier gravity oils, at least the heavier gravity of the oils as they were supplied at the treating plants. I must confess that I was personally somewhat worried as to the possible effect those oils might have on the penetration and absorption in our ties.

We received some oils at one plant that had a gravity, as I remember it now, of a little over 1.12, and I immediately asked that the treatment at that particular plant be stopped until we had had an opportunity to investigate what would happen. I called a meeting at that particular plant of all officials of the engineering and purchasing departments, and we made a good many experimental runs of red oak ties which we were particularly interested in, and, of course, those presented a difficult problem to penetrate, and we went very carefully

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into the investigation of a number of runs using an English distillate oil which was still available as compared with this heavy oil. We also assured ourselves by securing samples of the original oil and the original tar which were used in making the coal tar solution which was used.

We found, as stated by the Chairman of the Committee, that the original oils had a gravity exceeding 1.09, very liquid oils, to which approximately 20% of the particular coal tar was added. We then made a number of runs in the actual cylinders, full charges of the English oil, as well as full charges of the solution, and as well as half ties in the individual run, and I think the absolutely unanimous opinion of all those present at the time was that we could tell practically no difference in the penetration of the ties with these heavy oils when compared with the English oil; in fact, it was somewhat amusing that a large percentage of those present voted that the penetration of the coal tar was really better than we received from the English oil. I may say that most of the gentlemen present did not know anything about the problems under discussion. They were simply asked in as impartial observers to note the results.

We are confronting the actual condition of oil supply. Whether it is wise to put that in the temporary form suggested by Mr. Teesdale I do not know.

I have also personally been a strong advocate of intense publicity in these matters. You remember what happened some 7 or 8 years ago when we first suggested adopting something in the Maintenance of Way Association. Somebody said we were buying upon specifications, but that we were all taking something that did not come within a mile of filling the specifications. I am personally rather strongly of the opinion we have already changed the allowable limits simply in order to be honest with ourselves as to the present situation.

THE PRESIDENT: Has any other member anything to say on this subject? Are you ready for the question?

MR. E. B. FULKS: I would like to say that the Committee in making this statement that it has knowledge that these oils are being used with satisfactory results and so forth, used the word "satisfactory" with the meaning that these oils were being used and were giving a satisfactory penetration. We thought that was the only interpretation of the word "satisfactory" that need be thought of in this case. There can be no question as to the results given by such oils as this so far as their preservative value is concerned, and the only question that might come up in regard to a heavy oil like this to which nobody was accustomed was, can we get sufficient penetration. The Committee has had ample knowledge of its own. It is now supplemented

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by Dr. von Schrenk, and no doubt could be by others, that this oil does give satisfactory penetration and there is no reason why it should not. It is a liquid oil, and its expansion factor is not greatly different from the others so that it expands and it is thin, and there is no reason why it should not give as satisfactory penetration as any other.

Mr. Church brought up a point that had not even occurred to me that some people may have thought that this was a subterfuge for allowing us to put in more tar. That had not occurred to me. We never discussed that, for the reason that the specification now approved by this Association for a coal-tar solution amply protects those solutions as to the amount of tar that can be put in. We are not offering anything that changes those. The tests as to gravity, float, and so on, we are not asking to change. We are simply asking to change these gravities to cover the materials that a great many people are now using, to justify people who have changed their own specifications to cover this in doing it, and to cover the condition that actually exists.

The implication that the manufacturers are trying to do something, to get rid of something, I hardly think Mr. Larkin meant, because there is no necessity for that. As a matter of fact this oil that I describe, that is going into this 20-80 solution, that is sold to tie-treating plants, will fill the specifications of the Shipping Board and various such places as that, so we could sell every gallon at 15, 20 or 25 cents a gallon, and we would not want to come here with such a thing as this to get rid of that oil. We are doing this to justify people who are using such oil in using something that does not fill absolutely the specifications that they are using themselves.

As a matter of fact I personally have always considered that in a specification for oil a statement as to the gravity was meaningless and useless; but we have always been accustomed to have them, and so long as we have them let us have a description of what the thing is.

MR. A. E. LARKIN: Mr. President, it seems to me that the Chairman of the Committee has simply proved the statements I have made are true. He knows, as we all know, that he can dispose of that material. There is no question about that, and, of course, it is being disposed of, and there is not enough to go around, but I venture to say that Mr. Fulks and Mr. Church have been approached by consumers asking if they could not get a material that would have a smaller tar content. I have visited a good many plants this last year where there was a big complaint about the tar residue in the preservatives being supplied.

There is another point that I think should be considered in this connection. You know there are a lot of people in the industry that

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look to the Association for their standards. Do you think it will look well or have any particularly good influence on the individuals from the Association's standpoint if we change this specification from year to year? We adopted a specification last year. It was thought by the Committee at that time that sufficient work had been done on the matter of preservatives so that it would not be necessary to change it again for a number of years. Now conditions have arisen, especially in connection with the manufacture and production of preservatives that require another change to accommodate the manufacturers and apparently we are quite ready to step in and revise our specifications.

I believe it will simply make the consumers lose confidence in the Association's standards. Now, referring to the President's remarks a minute ago, about there being perhaps no necessity for another change for a number of years, or rather that the Committee considered now that there would not be the necessity for a further change for a number of years, we do not know but that the same thing will happen next year. I think we ought to be very slow to change these standards, because as soon as we get out a standard it is handed to the prospective customer and to the engineer who is drawing specifications as a standard. Well, we submit one standard one year and here is a new standard the next year.

Do you realize the proposed changes all point in the same direction? The discussion last year brought out fully the fact that we were drawing a specification to permit the use of a large quantity of tar and officially recognizing it. Now, regardless of the statement to the contrary, if you increase the maximum gravity you are going to get more tar, because the manufacturer is going to fill the specification. It may be quite true that the oils are being depleted to some extent of their lighter fractions, and that might be responsible to some extent for the heavier gravity requirement, but nevertheless, the proposed change does provide for the larger tar content material to be supplied under that same specification, because the very slight increase in gravity due to the loss of the lighter oils would not make any appreciable difference.

I have noticed that the A. R. E. A. has not changed its standard at the request of any manufacturer and on account of the general conditions. It is confronted by exactly the same situation that we are, and yet the A. R. E. A. maintains its standards. That fact does not mean that the A. R. E. A. is always able to get what it specifies, and it does not mean that in some cases it is not advisable for the A. R. E. A. to accept something that does not meet its specification, yet you can look at the A. R. E. A. specification as a standard that has been a standard for a long time, and you, therefore, have con-

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fidence in its value, whereas we adopt a specification one year and the next year we change it to accommodate one or two manufacturers.

THE PRESIDENT: Gentlemen, of course changing just for the sake of changing is not desirable, but if we never changed we might never progress. It is for you gentlemen to say in the vote you are going to give us whether you believe the change recommended is one that you approve or not. All those in favor of the change recommended by the Committee please say "aye"; contrary, "no." The "ayes" have it.

MR. E. B. FULKS: The next deals with the same thing in regard to coal-tar oil for paving blocks. It is proposed to raise the maximum gravity from 1.12 to 1.14. I move the adoption of this recommended change.

MR. O. C. STEINMAYER: I second the motion.

THE PRESIDENT: It has been regularly moved and seconded that the specific gravity of the coal-tar oil for paving blocks (which the present standard gives a specific gravity of 1.07 to 1.12) be changed so as to read that the specific gravity "shall be not less than 1.07 nor more than 1.14." Any discussion of that recommendation? All those in favor of the recommendation of the Committee will please say "aye"; those opposed, "no." The recommendation is approved.

MR. E. B. FULKS: The Committee was instructed to investigate and report on specifications for creosote corresponding to A. R. E. A. grades 2 and 3. In regard to this I would call attention to what the Committee says, in concluding its report.

The Committee's position in regard to this is that the Association approves a specification for a type of material which it considers a good specification. It does not mean that the Association says everybody shall use that material. It gives them a type of specification.

If to meet certain conditions, local or otherwise, somebody feels called upon to have a specification for the same sort of material but of a little different quality he can adapt this specification to the changes. It seems to me that that is a better position for the Association to take than to adopt what it calls standard specifications for say three types of the same thing. It seems to me it would be just as pertinent for the Association to have two or three specifications for different qualities of zinc chloride, which of course is absurd. Although the Committee does not feel strongly on this one way or the other, it simply puts it in this manner and leaves it without recommendation. We would be glad to hear what the people have to say.

THE PRESIDENT: Does anybody care to discuss the specification for an oil corresponding to A. R. E. A. grades 2 and 3?

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DR. HERMANN von SCHRENK: I move it be accepted as information.

MR. O. C. STEINMAYER: I second the motion.

THE PRESIDENT: It is regularly moved and seconded that the specification given by the Committee on pages 171 and 172 be accepted as information. All those in favor will say "aye"; contrary, "no." The "ayes" have it.

MR. E. B. FULKS: The Committee was instructed to make some investigations in regard to sampling, and that had particular reference to sampling for water in tank cars which had been started, over a year ago, under the auspices of the committee from the A. R. E. A., got well started and then stopped, mainly for lack of time. Very little was done, but the work was started slightly and only got a little piece until the Committee saw that this was involved in the same thing that is apparent from Mr. Church's paper, that the question of expansion, heating, and all that sort of thing was intimately tied up with this sampling. In other words, on our zone scheme the determination of the top zone is very much involved and depends on the state of the oil, and we simply had no time to go ahead and do all that. We had to drop it and leave it for some future committee, or for a future time.

We were instructed to investigate a specification for oil for use in non-pressure treatments. The Committee consulted with the Chairman of the Committee on Non-Pressure Treatments who recommends that three specifications for preservatives be reported, corresponding to the three general classes of non-pressure treatment, viz., brushing, dipping and open tank.

The Committee was somewhat handicapped in following this instruction literally, for the reason that the Association has no specifications, and in the past it has had very little discussion about non-pressure treatments, so that it seemed almost like getting the cart before the horse to write specifications for different sorts of treatments when we did not know how those treatments were to be carried out. Therefore, we thought rather than present a lot more specifications it would be better for us simply to offer as information a specification which seemed to us to be pretty good, and to leave the consideration of definite specifications for oil for particular methods of treatment until such time as those methods are provided. We offer this as information.

DR. HERMANN von SCHRENK: I move it be accepted as information.

MR. J. H. WATERMAN: I second the motion.

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THE PRESIDENT: It has been regularly moved and seconded that the specification for non-pressure oil be accepted as information.

MR. L. L. HILL: Mr. President, if I understand it correctly, there is no greater preservative value in oil of a character of that mentioned on page 174 than there is in creosote, in which a greater distillate has permeated at a temperature of 235° C., or in other words, creosote conforming to the No. 1 specification, and therefore, the only advantage in the creosote under discussion is a smaller loss by evaporation.

Now, if I am correct in this, would it not be unwise to specify this oil or even receive this specification for information, because it would have the effect of causing customers to require the use of this oil in butt-treating poles under the non-pressure system, and would thereby narrow the field of purchase for the operator without producing any greater efficiency in the treatment?

I would like to hear from Mr. Teesdale as to what he thinks about it, or from somebody else, who knows more about the subject than I do.

MR. S. R. CHURCH: I am sorry Mr. Teesdale is not here to speak for himself, but I had some correspondence with him, and this specification is in accordance with his recommendation; in fact, he was somewhat instrumental in getting the Shipping Board to adopt it for use in connection with the brush treatment of ends of timbers in the construction of ships.

MR. E. B. FULKS: The Committee does not undertake to sponsor this specification for anything. We simply submit it as a type. If anybody had to have a specification, that is a good oil. There is no doubt about that, and that is one that has been proposed to us and happens to be one that the Shipping Board is using for brush treatment on the timbers in the ships that it is building, so we put it in here as a suggestion. The very points brought out simply strengthen the point of the Committee in its position in not submitting specifications at this time for oils for non-pressure treatment.

MR. L. L. HILL: Mr. President, I recognize the point, but notwithstanding that, would it not have an influence on the purchaser of the treated wood? If this creosote has no greater preservative value, and therefore will not preserve the wood for a greater length of time, and the only advantage is that there will be less loss through evaporation, is it not merely a question of price and one which is up to the operator to decide?

THE PRESIDENT: While it is possible that a reader of the PROCEEDINGS will use this specification instead of another, such a result is rather hard to avoid if he will not read the rest of the report and

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find that the specification has been given simply as information. It is specifically stated as not standard. If someone were to write to the Association this year and ask for its standards, this specifiaction would not be given. During 1918 there will not be in the MANUAL a specification for non-pressure oil. It is rather hard to see how the Association can ignore what the Committee has presented.

It is information on which a real specification may be built next year. If there is no further discussion we will call for the question. All those in favor of accepting this specification as information will say "aye"; those opposed, "no." The "ayes" have it.

MR. E. B. FULKS: The Committee under its instructions made considerable further investigations of some of the special tests that were introduced last year, particularly the float and coke test, but results were so largely satisfactory that it has no changes to suggest.

After the promulgation of the standards last year there were a number of inquiries received as to the meaning of the expression about specific gravity, that is the temperature relation of 38/15.5° C. In response to that the Committee through Mr. Church published in WOOD-PRESERVING, Vol. IV., No. 3, page 44, a definition of this term and also an explanation of the proper and improper way of using it. Since it seems to be information of value to a good many people, the Committee suggests that this note as printed in WOOD-PRESERVING be printed in the MANUAL as a footnote to "3. Specific Gravity," page 312, PROCEEDINGS 1917. This does not mean to adopt any standard, but simply is explanatory note to some material that is in the MANUAL. I imagine there is no action necessary for that. I think that is all that relates to creosote oil.

For zinc chloride the Committee recommends an entire change of the specification proposed last year. You will remember last year there was considerable criticism of the Committee's recommendation, on account of it not having a minimum amount of zinc chloride content. Therefore, the Committee has fixed upon 94%. I move the adoption of this recommendation.

MR. S. R. CHURCH: I second the motion.

THE PRESIDENT: It has been regularly moved and seconded that the zinc-chloride recommendation be changed to read as follows:

> The zinc chloride shall be acid-free and shall not contain more than 0.1% iron. Fused or solid zinc chloride shall contain at least 94% chloride of zinc. Concentrated zinc-chloride solution shall contain at least 50% chloride of zinc.

Is there any discussion of this new zinc-chloride specification?

MR. C. H. TEESDALE: I would like to ask, Mr. President, on what data the limitation for 0.1% is based.

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DR. A. L. KAMMERER: Last year the limit was placed at 0.5%, and various manufacturers complained of the very great discoloration that was brought about in the chloride, and one manufacturer in particular submitted samples to the Committee containing percentages of iron varying from 0.1 to 0.5, and when the iron content was as much as 0.5% the fused chloride was almost blood red in color, due to the precipitated iron. In the concentration of the zinc chloride solution the iron is thrown out of solution and very strongly discolors the fused mass, and this off-color is considered to be prejudicial to the product.

MR. C. H. TEESDALE: That is simply a question of appearance, as I understand it. During the last year we collected samples of zinc chloride from a number of treating plants and analyzed them for their iron product. Some of the samples were taken from solutions which had been used several times, and some from tanks where the solution had been very newly mixed. We found that the amount of iron in those solutions would run to about 0.5%, that is, they would come within the specification calling for 0.5% iron as iron, not as iron chloride, but in many cases they very closely approached that point, in some cases they even ran over that amount of iron. If that is the case with the solutions as they are used in the treating plant why would not your raw material show that iron content? If the solution is going to take up a considerable amount of iron, while it is in storage or in use, why put any limit on the amount of iron in the zinc chloride as purchased?

DR. A. L. KAMMERER: We took up the point with the manufacturer as to whether the amount of iron, if it was increased to allow 0.5% would in any way affect the cost of manufacture, or if they could put the material on the market at a lower cost, and the few concerns that replied said it would not affect the cost, and they also further wrote that it worked no material hardship on them to meet the 0.1% requirement. So it sifts down really to this question of appearance.

MR. C. H. TEESDALE: I was informed by one group of people, manufacturers of chloride, that they could compete to greater advantage if the limit on iron was raised to 1%, and it was on that account largely that we conducted this investigation.

DR. A. L. KAMMERER: The Committee tried to get information on that point and could not get any definite promise that it would lower the cost of production.

MR. C. H. TEESDALE: I believe that they are going ahead on the basis that the specification will call for 0.5%, and if it is changed it might involve considerable expense to them in redesigning their plant.

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DR. A. L. KAMMERER: May I ask if this refers to the production of the solid or the liquid.

MR. C. H. TEESDALE: I think that they planned to produce either type.

DR. A. L. KAMMERER: It has been shown that in manufacturing fused chloride when the material reached a certain concentration the iron is precipitated and it makes a very nasty-looking product, and the ordinary consumer would not recognize it as zinc chloride. It looks more like chromic acid, almost as red as the red in that flag (pointing to the Association's Service flag behind the President) if it runs up to 0.5%.

MR. C. H. TEESDALE: We studied this solely from the standpoint of the amount of iron content in the solution after it was prepared, and from that standpoint there would seem to be no good reason why the limit should be raised above 0.5%, and also there would seem to be no good reason why it should not be permitted to be 0.5%. We told them we did not think it would be advisable to raise it to 1%.

DR. A. L. KAMMERER: Another point that appears in literature from time to time is that iron in the form as it appears in zinc chloride is very harmful. Whether they refer to injury to the treating apparatus or to the ties or to the rail fastenings, I do not know. I know of no data to either refute or affirm these statements.

MR. E. B. FULKS: The whole thing seems to get down to the point that we seem to get to every year when we discuss zinc chloride. We try to get the information out of the manufacturers and we do not get it, but we get something, and then when we boil it down and come up here all the information we have does not seem to fit all the facts. To narrow it down, the Committee after an inquiry among all the larger manufacturers found that it seemed they could manufacture a product of 0.1% just as easily as a greater percentage of iron and would do it for just as little money.

DR. HERMANN von SCHRENK: Mr. Chairman, in buying zinc why allow any more iron in it than we have to have?

MR. E. B. FULKS: That was the attitude of the Committee exactly.

MR. C. M. TAYLOR: Mr. Chairman, I thought at one time that there would be some manufacturers come along who probably would not be able to make the beautiful white zinc chloride. We have been unable to get anybody to come along to prove to us by allowing 0.5% iron in zinc chloride that we would save money, and we are here to save money. You remember the old specification was much lower

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than this. I am awfully sorry we have not had this information before. I doubt whether some of these follows would use some of this 0.5% iron of zinc chloride. If they saw it they would be scared. Some of the consumers have been getting practically white zinc chloride, and they would say it was not zinc chloride, no matter what you would tell them. It is almost as red as the red in the flag when you get 0.5% of iron in it. We do not know what harm iron does. Confirming Mr. Teesdale's remarks, zinc solutions that do contain 0.5% of iron have been used and on tram cars and everything else and its effects are not noticeable. I doubt whether we should change our recommendation in the matter, unless we find that we can get it 2 or 3 cents a pound cheaper by making that 0.5%.

MR. C. H. TEESDALE: I did not know anything about this proposed change in the specification, or I could have placed you in communication with the people that I have in mind. I have one suggestion, and that is that this matter might be held over until tomorrow, and in the meantime I can get into telephone communication with these people.

MR. E. B. FULKS: Gentlemen, this zinc chloride matter seems always to confuse things, and information has come to the Committee which it did not have before. It seems rather important, so the Committee will withdraw this and ask that it be referred back for another year, and let the specification as it is now adopted stand. If that is allowable, that is all there is to it, except the Committee along the same line has been unable to get any help at all from manufacturers about the method of sampling zinc chloride. They do not know how to do it, and the manufacturers have not helped them. Of course, that is largely because they have been busy. We cannot blame them so much for that, but we are still in the same position as we were last year of not being able to propose a method for sampling zinc chloride. We do describe a method that can be used, but this, of course, is rather cumbersome and may not help out a great deal, but we offer it here for information.

MR. J. H. WATERMAN: Will not the Committee submit for information what it has?

MR. E. B. FULKS: Yes. We do submit it here. It is printed in here.

MR. J. H. WATERMAN: I understood you were going to withdraw it.

MR. E. B. FULKS: No; I say we withdraw the proposed specification, but we submit for information a method for sampling.

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MR. J. H. WATERMAN: Will you submit the proposed specification for information?

MR. E. B. FULKS: Yes; it is printed in here. We cannot get it out. It will have to stay there. The President suggests, and I think it would not be a bad policy, to put it in as information. The Committee is indifferent on the subject.

DR. HERMANN von SCHRENK: I rise to a point of order. I think we ought to adopt that specification. We are buying lots of zinc nowadays, and we have been haggling about this iron business for years. The thing started out with the Prussian Government specification which some of us brought over years ago, which practically said that a microscopic percentage of iron only would be allowed. Then some manufacturers kicked about that and said they were having a hard time to produce a product as free from iron as was required by the specification. We then went to work and changed the specification, and admitted a slightly increased percentage of iron in order to make it commercially practicable to deliver the material at a low price. Here the Committee has gone to work and has put up the percentage allowed now of 0.1%.

As I just stated we are now buying zinc chloride. As I understand from the Committee it has consulted the largest manufacturers that were willing to give any information, and they all say they can make zinc chloride as low as this and not increase the price to us. Why then should we increase the percentage of iron allowed? After all, we are paying for zinc and not for iron.

Some of us in the treating game have always been suspicious of iron. It has curious properties with respect to absorption. Whether it has been responsible for some of the troubles we have I do not know. I was talking to an engineer recently, and he has become so suspicious of the presence of iron in his manufacturing processes as a possible reason for spontaneous ignition that he does not want to have anything to do with any iron compound.

I will make a motion again that this specification be adopted. If you should find that there is a large percentage of men who, if we raise the percentage of iron admitted, could make cheaper zinc chloride, that is another story.

MR. J. H. WATERMAN: I second the Doctor's motion.

MR. E. B. FULKS: Mr. Chairman, one member of the Committee says we ought not to be so wish-washy, we ought to take a stand, so it will with withdraw its offer to take this back until next year, but it will ask to hold the matter open until tomorrow. Mr. Teesdale may be able to give us some information that is important,

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and I think that perhaps by tomorrow we may be further along. So if you will permit us to do so we will hold it over and bring it up again tomorrow.

THE PRESIDENT: Gentlemen, that adds to tomorrow's program. We will adjourn now until 6:30, when we hope everyone will be here to attend the informal dinner.

The meeting then adjourned.

THURSDAY MORNING SESSION.

January 24.

The meeting was called to order by President Foley at 10:30 A. M.

THE PRESIDENT: We will hear again from the Committee on Preservatives.

MR. E. B. FULKS: Late yesterday evening, toward the close of the dinner, Mr. Teesdale came to me and told me that he had been in communication by telephone with the gentlemen to whom he referred during the afternoon and he says they told him they did not care to press the point that he had brought out in regard to the amount of iron allowable in the zinc chloride, so Mr. Teesdale is very sorry he stated anything about it, and if we would just consider it all over and go ahead and move the adoption of the report as far as he was concerned it would be all right, so I now move the adoption of that clause in that report.

THE PRESIDENT: It has been regularly moved and seconded that the following specification for zinc chloride be approved at this meeting:

> The zinc chloride shall be acid-free and shall not contain more than 0.1% of iron. Fused or solid zinc chloride shall contain at least 94% chloride of zinc. Concentrated zinc-chloride solution shall contain at least 50% chloride of zinc.

Is there any discussion? All those in favor will please say "aye," opposed "no." The "ayes" have it.

We will now hear from the Committee on Terminology. The members of this Committee present will please come to the platform.

MR. F. J. ANGIER: Mr. President and Gentlemen, unfortunately the Chairman of your Committee, Mr. Shipley, is not here this morning, and I have been requested to present the report. Mr. Grady is also absent, and this is also unfortunate, because I believe he did more good hard work than any other member of the Committee. Mr. Fisher, although not a member of the Committee, rendered valuable service, and much credit for what has been accomplished is due him.

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REPORT OF COMMITTEE ON TERMINOLOGY.

To the Members of the American Wood-Preservers' Association:

Your Committee on Terminology submits herewith its annual report for 1918. Two meetings of this Committee were held during the year; the first in Chicago on March 19, 1917, attended by the following members: J. B. Card (Chairman), W. H. Grady, J. H. Grow and F. J. Angier.

In August Chairman Card volunteered his services as a candidate for a commission in the Officers' Reserve Corps, and G. B. Shipley was appointed Chairman, Mr. Card remaining a member of the Committee.

The Committee held a 2 days' session at the Pittsburgh Athletic Association at Pittsburgh, November 23 and 24. There were present at this meeting as members, G. B. Shipley (Chairman), W. H. Grady, J. H. Grow and F. J. Angier, and also Wm. A. Fisher.

In preparing this report your Committee has confined its efforts to the definition of such terms as are especially related to the wood-preserving industry. Some machines described are not in themselves necessarily peculiar to this industry, but as they perform specific functions which are essential to it, they are included. For example: vacuum pumps and air compressors perform functions which are necessary, and they have been included in this report. On the other hand, the duties of a generator or boiler are the same in a wood-preserving plant as in any other plant, and therefore, are not included.

RECOMMENDATIONS FOR NEXT YEAR'S WORK.

Your Committee recommends for next year's work a continuance of the study of Terminology, including:

First: Definitions of such laboratory and other apparatus as is commonly used about a timber-treating plant.
that are destructive to untreated timber.

Second: Description of the various types of marine borers

GRANT B. SHIPLEY, *Chairman*,
F. J. ANGIER,
J. B. CARD,
W. H. GRADY,
J. H. GROW.

Abbreviations.

Board Measure	B. M.
Center Matched	C. M.
Dressed and Matched	D. & M.
Feet Board Measure	F. B. M.
Square Edged	S. E.
Square Edged and Sound	S. E. & S.
Specific gravity at 38/15.5 means specific gravity at 38° as compared with water at 15.5°	38/15.5

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Surfaced four sides	S. 4 S.
Surfaced one edge	S. 1 E.
Surfaced one side	S. 1 S.
Surfaced one side and one edge	S. 1 S. 1 E.
Surfaced one side and two edges	S. 1 S. 2 E.
Surfaced three sides	S. 3 S.
Surfaced two edges	S. 2 E.
Surfaced two sides	S. 2 S.
Surfaced two sides and one edge	S. 2 S. 1 E.
Thousand feet board measure	M. B. M.

absorption, gross—Total amount of preservative injected into the timber during the treating operation. (See net absorption.)

absorption, initial—A certain amount of preservative absorbed by the timber during the filling process and before the pressure is applied.

absorption, net—Net amount of preservative left in the timber after completion of treating operation. (See gross absorption.)

adzed tie—(See tie, adzed.)

air coils—Perforated coils, sometimes located in bottom of tanks, used to agitate preservative with compressed air.

air compressor—(See compressor, air.)

air dried—(See air seasoned.)

air, preliminary—Compressed air applied to timber before introducing preservative. Sometimes used with empty cell treatment as an aid to final vacuum in removing surplus oil.

air receiver—Reservoir or tank for storage of compressed air.

air seasoned—Wood seasoned under ordinary atmospheric conditions, either sheltered or exposed, without any artificial source of heat. Thoroughly air-seasoned wood, depending upon climatic conditions, contains from 10% to 20% moisture, based on oven-dry weight of wood.

annual ring—Distinct concentric marking on the cross-section of timber, indicating annual growth of the tree.

bale, tram—Detachable half circle of bar steel attached to the arms of tram cars and conforming to the cylinder shell, to clear same when tram enters. Prevents timber floating off trams during treatment.

bell end—A pile showing rapid increase in diameter near the butt is sometimes said to have a bell end. (See ground swell.)

bichloride of mercury—(See mercuric chloride.)

bleeding—A heavily treated piece of wood will sometimes exude oil from its pores, when exposed to external heat, such as the sun's rays. This is spoken of as bleeding.

block machine—Gang saw for cutting lumber into paving blocks.

block mill—Saw mill arranged for manufacturing wooden paving blocks.

block, nose—Block having the edge on one end beveled off. Sometimes used along car tracks where T-rails are laid.

blow back—(See piping.)

blow off line—(See piping.)

blue sap (blueing)—(See sap stain.)

board foot—Unit of measure representing the equivalent of a board 1 inch thick and 1 foot square.

board measure—Expression of board foot content.

bored tie—(See tie, bored.)

borer, increment—(See increment borer.)

boxed end—Butt end of a pine pile or pole showing the scars due to boxing or cutting trunks of growing trees for resinous products.

brush treatment—Application of a preservative with a brush. Preservative is usually applied hot.

burnettize—Term used in connection with the zinc chloride treatment, patented by Sir William Burnett.

butt—Large end of a pile or pole.

butt treatment—Process wherein only one end of the material is treated. Usually refers to the butt end of piles or poles, and an open tank is generally used.

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car, block—Tram cars arranged with cages for handling paving blocks. Sometimes called block cages.

car, bolster—Tram cars arranged with swivel arms for handling piles, poles and long timber.

car, tie—Trams used for cross-ties and other short timber.

car, tram—Metal car used for transporting material for treatment, to and from the treating cylinders, and about the yard.

carbon, free—Insoluble carbon contained in coal tar. Coke-oven tar usually contains from 2 to 10% of free carbon, and is known as low-carbon tar. Gas-house tar usually contains from 15 to 30% of free carbon, and is known as high-carbon tar.

case hardening—When a stick of timber seasons so rapidly that all free water at the outer surfaces of the piece evaporates before the water in the interior has time to transfuse outwardly, the hygroscopic moisture in the outer shell of the piece will begin to evaporate although there is still free water in the interior. The loss of hygroscopic moisture from the outer shell tends to make it shrink. The wet interior prevents this shrinkage and tensile stresses are set up in the outer shell of the stick. As seasoning progresses, this outer shell hardens and "sets" in this stressed condition. This is case hardening.

As seasoning continues, the interior tends to shrink, but is prevented from doing so by the hardened exterior shell. Thus tensile stresses are set up in the interior of the piece. If the strength of the wood is not sufficient to withstand these stresses it will crack or split. Result is internal checking or splitting, which usually takes place along the medulary rays. This is called "honeycombing" or "hollow horning."

charge (noun)—Material assembled for treatment in one cylinder.

charge (verb)—Act of placing material into cylinder for treatment.

check, season—(See season check.)

compressor, air—Pump for compressing air above atmospheric pressure. Air is used for various purposes, such as blowing back solution from treating cylinder to working tank; agitating mixture of preservative; unloading preservatives from tank cars to storage tanks, and forcing preservatives into wood in the treating cylinder where hydraulic pumps are not used.

condensor—An apparatus separate from cylinder in which the exhaust steam, oil vapors, etc., are condensed by the action of cold water. Three forms of condensors are employed in connection with vacuum pumps—jet, surface and barometric.

copper sulphate—A salt, strongly toxic against wood-destroying fungi. First used as a timber preservative in England by Margary about 1837.

corrosive sublimate—(See mercuric chloride.)

creosote—An oil obtained by distillation from coal tar. In commercial usage the term is also applied to creosote oil in which some coal tar is dissolved. Creosote oil has a specific gravity above 1.0, and boils between 200° and 400° C. It consists principally of aromatic hydrocarbons and contains naphthalene, anthracene, phenols, and bases in widely varying proportions.

crinkle iron—(See S iron.)

cubic foot—Unit of measure commonly used in computing contents of cross-ties and absorption of preservative.

cylinder anchor saddles—Heavy supporting casting riveted to cylinder at the center point and fastened to the foundation with anchor bolts. Loose saddles are used at all other supports to allow for expansion and contraction of the cylinder.

cylinder coils—Steam heating coils or radiators located in treating cylinders, used for heating preservative during treatment.

cylinder door—(See door, cylinder.)

cylinder door bolt keepers—Brackets or straps for securing swing bolts to the door frame of cylinder.

cylinder door frame—Rim attached to end of cylinder for receiving the door. Usually made from a one-piece steel casting.

cylinder door hinge pins—Pins for securing cylinder door to frame at hinge joints.

cylinder door roller—Small wheel attached to bottom of door to support same when being opened or closed.

cylinder door track—Short curved monorail track for door roller when door is opened or closed. Usually imbedded in the concrete floor.

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cylinder flanges—Reinforcing plates riveted to cylinder for inlets and outlets.

cylinder guard rails—Guides for preventing trams from floating off cylinder track.

cylinder guard rail brackets—Castings or steel connections riveted to cylinder shell for holding guard rails.

cylinder, horizontal treating—Container arranged with inside tracks for treating wood loaded on tram cars. (See retort.)

cylinder house—Building in which treating cylinders are located.

cylinder line—(See train cable.)

cylinder nozzles—Special castings riveted to cylinder and used for connecting pipe inlets and outlets.

cylinder saddles—Castings for supporting cylinders. Upper side conforms to cylinder, lower side is plane. They rest on iron sole plates fastened to the foundation and are left free to slide on these plates with the expansion of the cylinders. Steel rollers are usually placed between the saddle and sole plates.

cylinder sole plates—Foundation plates. Plane on the upper surface and anchored to the foundation. Cylinder saddles rest on these plates.

cylinder thermometer bracket—Special casting riveted to cylinder for receiving the thermometer.

cylinder track—Track placed in cylinder for supporting tram cars.

cylinder, vertical—Container into which the wood is loaded in bulk without the use of tram cars, used almost entirely for treating paving blocks.

dating nail—(See nail, dating.)

dead oil of coal tar—(See creosote.)

dock, loading—Platform or fill constructed of concrete or timber on which are arranged tram-car tracks for handling of material from tram cars to standard gauge cars or vice versa.

door, cylinder, bolted—1. Built up: Door constructed from two or more pieces of material. Usually made with a steel-plate center riveted to a cast-steel rim.
2. Solid: Door built in one piece. Usually a solid steel casting.

door, cylinder, spider—Door secured to the treating cylinder by arms radiating from, and tightened by, a central screw.

door bolts, through—Plain straight bolts for securing door to frame of treating cylinder.

door bolts, swing—Bolts with T-heads secured to the door frame and so arranged that they may be swung into the door bolt slots when the door is closed.

drain line—(See piping.)

dry oil—(See water-free oil.)

edge—Either of the two narrower longitudinal surfaces of a stick of lumber.

empty cell treatment—A treatment wherein the surplus preservative is removed, leaving the wood cell walls coated and the cells more or less empty.

exhaust steam—(See steam, exhaust.)

expansion factor—As the volume of a given weight of oil varies according to its temperature, it is necessary to employ a factor for reducing all calculations to a fixed agreed temperature, which is usually taken as 100° F. Creosote oil expands about 1% for each 22½° rise in temperature. (See expansion factors, approved by this Association.)

fiber saturation point—Name given to the condition of wood when the cell walls are saturated with moisture and no free water is present. The moisture content of wood at the fiber saturation point is 20 to 30% of its oven-dry weight.

filling line—(See piping.)

final vacuum—(See vacuum, final.)

free carbon—(See carbon, free.)

free water—(See hygroscopic moisture.)

full cell treatment—Treatment to refusal, leaving the wood cells full of preservative.

fungi—Plural for fungus.

fungus—A plant, some forms of which grow on and feed upon wood, destroying the latter by decay.

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gas-house tar—(See tar, coal-gas.)

gauge, clock—(See indicator, dial.)

gauge, float—Gauge made by attaching a float to one end of a cord or chain, the other end of the chain passing over the top of tank and down the side, and to which a weight is attached. Any change of level of the liquid in the tank causes this weight to pass up or down a board which is usually graduated in feet.

gauge, mercury—Gauge for recording volume of solution in tanks, which registers by pressure, therefore, does not require temperature correction.

gross absorption—(See absorption, gross.)

ground swell—The rapid increase in diameter seen near the butt on some piles and poles. Sometimes found in cross-ties. (See bell end.)

guard rail—(See cylinder guard rail.)

guard rail brackets—(See cylinder guard rail brackets.)

heartwood—The older and central part of a tree, usually darker than the sapwood.

heart penetration—(See heart treatment.)

heart shake—(See shake, heart.)

heart treatment—Treatment wherein all or most of the heartwood as well as the sapwood is penetrated with the preservative. Heartwood of most species offers greater resistance to treatment than sapwood.

heating coil covers—Perforated plates fastened over the coils to protect same.

heating coil manifolds—Castings or built-up headers, used for connecting coils to steam connections.

heating coil supports—Brackets or straps for holding coils in place.

hollow horning—(See case hardening.)

honeycombing—(See case hardening.)

hygroscopic moisture—Unseasoned wood contains moisture in two forms; (1) as free water, that is as small particles of liquid water occupying the capillary spaces in the wood; (2) as hygroscopic moisture intimately absorbed by the substance of the cell walls.
Wood gives up its free water without shrinking, but the slightest loss of the hygroscopic moisture (that is, the reduction of the moisture content below the fiber saturation point) causes shrinkage.

impregnation—(See penetration.)

increment borer—A hollow augur, which when bored into timber extracts a core from which the penetration of preservative may be determined.

indicator, dial—Gauge similar to a clock dial, calibrated to indicate the quantity of preservative in tank. Consists of a dial having clock hands, connected through a system of gears with a drum which is operated by a float in tank.

initial absorption—(See absorption, initial.)

kick back—Rebound of preservative due to releasing pressure on cylinder.

kiln dried—Lumber artificially seasoned in dry kilns by means of hot air or steam, circulated through the piles. Thoroughly kiln-dried lumber contains about 8% moisture, based on oven-dry weight of wood. Time required to kiln dry lumber depends upon the species of timber and size of pieces, varying from a few hours to several months.

knot—A hard mass of wood formed in the trunk of a tree by a branch, with the grain distinct and separate from the grain of the trunk.

knot, encased—Surrounded wholly or in part by pitch or bark.

knot, large (pine)—A sound knot over 1¼ inches in diameter.

knot, loose—Not held firmly in place by growth or position.

knot, pin (pine)—A sound knot ½ inch or less in diameter.

knot, pith—A sound knot with a pith hole not more than ¼ inch in diameter.

knot, rotten—Unsound and not as hard as the wood surrounding it.

knot, round—Circular or oval in form.

knot, sound—Solid across its face, as hard as the wood in which it is located, and so placed by growth or position that it will retain its place in the piece.

knot, spike—Sawn in lengthwise direction.

knot, standard (pine)—A sound knot 1½ inches or less in diameter.

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kyanizing—Term sometimes used in connection with bichloride of mercury treatment, patented by John H. Kyan in 1832.

leach—To dissolve out. Used in the sense of loss of preservative from timber by the action of water.

loading dock—(See dock, loading.)

margarylze—Term sometimes used in connection with the copper sulphate treatment, patented by Margary in 1837.

measuring tank—(See tank, measuring.)

mercuric chloride—A very toxic and exceedingly poisonous salt used for preserving timber. First used for the purpose by Kyan in England about 1832.

mixing pump—(See pump, mixing.)

mixing tank—(See tank, mixing.)

nail, dating—A galvanized nail with a large head, on which the last two numerals of the year are stamped. These nails are driven into the upper face of treated ties to indicate the year in which they were treated.

naphthalene—A constituent of coal tar or creosote distilling between 205° C. and 255° C. It is solid at room temperature. Coal-tar creosote usually contains from 15% to 45% naphthalene unless this has been removed for commercial reasons.

net absorption—(See absorption, net.)

nose block—(See block, nose.)

oil, dry—(See dry oil.)

oil, season—(See seasoning oil.)

oil, water free—(See water-free oil.)

oil, wet—(See wet oil.)

open-tank plant—(See plant, open-tank.)

out of wind—Having the longitudinal surfaces plane.

overhead tank—(See tank, overhead.)

pecky—A term applied to a defect of the heartwood of cypress, consisting of pecks or holes, due to a fungus disease.

penetration—Depth to which preservative enters wood, usually determined by boring with an increment borer or common augur. These holes should always be plugged with a treated plug.

penetration, heart—(See heart treatment.)

pile—A timber to be driven or jetted into the ground for supporting superimposed loads.

piling—Piles considered collectively.

piping, blow back—A pipe run from the bottom of treating cylinder to top of working tank. Its principal function is to release the pressure in the treating cylinder to enable the larger valves to be opened. Also to blow back to the working tank the small remaining amount of preservative in treating cylinder, and often takes the place of the relief line. (See relief line.)

piping, blow off line—Pipe-line leading from treating cylinder to atmosphere, used to blow off steam after steaming. Also used to release air pressure.

piping, drain line—Pipe-line leading from cylinder to drain tank, used for draining cylinder.

piping, filling line—Pipe-line leading from charging tank to cylinder, used to fill cylinder with preservative.

piping, pressure line—Pipe-line leading from pressure pump or other source of pressure, to cylinder, through which the preservative is forced during treatment.

piping, relief line—Pipe-line leading from cylinder to top of charging tank through which pressure is released before draining cylinder. Air enters through this line during drainage.

piping, steaming pipe—Perforated pipe placed in bottom of cylinder and extending approximately its entire length, used for admitting steam directly into cylinder during steaming process.

piping, vacuum line—Pipe-line leading from top of cylinder to vacuum pump, through which oil vapors, air, etc., are drawn by the vacuum pump while the vacuum is being produced in the cylinder. A suitable condensor is usually located in this line to condense the vapors, steam, etc., that may come over from the cylinder. (Also see condensor.)

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pitch—Residue obtained from the distillation of tar. Coal tar will usually run about 50% to 60% pitch.

pitch pocket—Opening between the grain of the wood containing more or less pitch or bark.

pitch pocket, large—Over ⅜ inch wide or 3 inches long.

pitch pocket, small—Not over ⅛ inch wide.

pitch pocket, standard—Not over ⅜ inch long.

pith—Soft wood within the first annual ring.

plant, open-tank—Plant equipped with open tanks wherein timber is treated by submerging it in the preservative at atmospheric pressure.

plant, pressure—Plant equipped with high-pressure cylinders for impregnating wood under pressure, usually at from 100 to 200 lbs. per square inch.

platform, loading—(See dock, loading.)

pump, mixing—Pump used for mixing preservatives, usually a rotary pump.

pump, pressure—Hydraulic pump, usually duplex steam, used for maintaining pressure in the cylinder during treatment, for forcing preservative into wood.

pump, vacuum—Pump for reducing atmospheric pressure in treating cylinders.

rail chair—Castings or steel supports riveted to the cylinder shell and used for supporting the track rails.

refusal treatment—When the treatment of timber is continued under pressure until its absorption of the preservative ceases it is said to be treated to refusal. The pressure is usually continued from ½ to 1 hour after the refusal point is reached when it is desired to give the timber the heaviest possible treatment.

refusal point—(See refusal treatment.)

relief line—(See piping.)

retort—Often used to designate a treating cylinder.

retort anchor saddle, retort coils, retort door bolt keepers, etc.—(See cylinder anchor saddle, cylinder coils, cylinder door bolt keepers, etc.)

ring shake—An opening between annual rings.

S iron—A piece of flat iron about ⅛ inch thick and 1¼ inches wide, sharpened on one edge and bent to the shape of a letter S or Z with overall length 3 to 6 inches. Driven into the end of a split or checked tie so that the iron extends across the check in such a manner as to prevent further splitting or checking.

sample thief—Small container by means of which samples of preservatives are taken from tanks or other vessels at any desired depth.

sapwood—Live part of a tree next to the bark through which sap flows.

sap drum—Small tank or drum located below treating cylinder and used for collecting the sap or condensation during steaming.

sap penetration—(See sap treatment.)

sap stain—Discoloration of sapwood caused by attack of certain fungi which live upon the materials found in sapwood of newly sawn lumber. For southern pine, while this is considered a defect, it does not seriously impair the strength or durability of timber for treatment, and is not usually given much consideration.

sap treatment—Treatment of sapwood with little or no heartwood penetration. Heartwood of some species, such as white oak, beech, etc., is almost impervious to treatment. In such cases a thorough sap penetration is considered sufficient.

scars, turpentine—(See turpentine scars.)

seasoned, air—(See air seasoned.)

season check—Split or crack in wood caused by seasoning.

seasoning, oil—Partially green timber may be effectively treated by oil seasoning. Sufficient oil (creosote) is admitted to cylinder to entirely cover the timber, but not enough to fill cylinder. The oil temperature is gradually raised to about 200° F., and held for 3 to 6 hours before applying pressure.

seasoning, steam—(See steam, preliminary.)

shakes—Splits or checks in wood, causing a separation of the annual rings.

shake, heart—Shake separating heartwood from sapwood.

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shake, ring—(See ring shake.)

shake, through—(See through shake.)

shake, wind—(See wind shake.)

sheaves, yard—Sheave wheels located at turn points in yard and used for guiding haulage cables.

side—Either of the two wider longitudinal surfaces of a stick of wood.

sleeper—(See ties, cross-ties.)

solid cylinder door—(See cylinder door, solid.)

sound—Free from decay.

spider cylinder door—(See cylinder door, spider.)

springwood—Inner part of the annual ring formed in the earlier part of the growing season. Usually of a lighter color than summerwood.

square edge—Free from wane.

steam (verb)—(See seasoning, steam and steam, preliminary.)

steam, exhaust—Steam from which some energy has been utilized since generation, such as the exhaust from pumps, engines, steam coils, etc.

steam, live—Convenient term sometimes applied to steam direct from boilers or steam-lines and from which no energy has been utilized since generation.

steam, preliminary—Steam applied direct to green timber for artificial seasoning before introducing preservative. Air-seasoned timber is not ordinarily steamed.

steam, saturated—Steam of a temperature due to its pressure. All ordinary boilers produce saturated steam.

steam, superheated—Steam heated to a temperature above that due to its pressure. Special superheated attachments are required with the boilers.

steam vacuum—Vacuum applied immediately after steaming operation. Reduces moisture content of timber.

steaming pipe—(See piping.)

storage yard—Yard with suitable track layout, used for storing ties and timber for seasoning.

straight—A pile, pole or tie is considered straight when a line drawn from the center of the butt to the center of the tip lies wholly within the body of the piece.

summerwood—Outer part of the annual rings formed later in the growing season. Usually dense in structure.

sump—An open tank or receiver, usually a concrete pit, for receiving the overflow from condensor and drain system. Creosote, having a greater specific gravity than water, settles to the bottom and is recovered.

surfaced—Wood dressed or smoothed by a surfacer or planing machine.

swell butt—(See ground swell.)

swing door bolts—(See door bolts, swing.)

tank, charging—Tank from which a cylinder is filled. Usually 16 to 20 feet in diameter by 18 to 20 feet high, and generally elevated to allow filling cylinder by gravity.

tank, drain—Usually a horizontal, cylindrical tank, so located that cylinder may be drained into it by gravity.

tank, dump—(See unloading tank.)

tank, equallizing—Pressure tank placed above treating cylinder. In some plants used for filling cylinders, and equallizing air pressure.

tank, measuring—Some plants use a separate measuring tank in addition to the charging tanks. When so employed the treatment is measured from this tank after cylinder has been filled from charging tank. (See charging tank.)

tank, mixing—Tank equipped with agitating apparatus for mixing preservatives.

tank, overhead—(See charging tank and measuring tank.)

tank, storage—Tank for storing preservatives.

tank, underground—(See drain tank and unloading tank.)

tank, unloading—Usually a horizontal, cylindrical tank placed below a standard gauge track, to enable tank cars to be unloaded by gravity.

tank, working—(See charging tank.)

taper—Gradual diminution in diameter from butt to tip.

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tar acids—Organic acids found in coal tar, most of which are low boiling and soluble in water, and the most antiseptic constituents of creosote. Coal-tar creosote contains usually about 5% of tar acids. Water-gas tar contains no tar acids.

tar, coal (coal-gas)—Tar obtained as a byproduct from the destructive distillation of coal in the manufacture of coal gas.

tar, coal (coke-oven)—Tar obtained as a byproduct from the destructive distillation of coal in the manufacture of coke. About 10 gallons of tar are obtained in coking 1 ton of coal.

tar, water-gas—Tar obtained as a byproduct in the manufacture of water gas with steam, coke or coal and petroleum oil.

thief, sample—(See sample thief.)

thief, water—Glass sampling device for determining amount of water on surface of liquids heavier than water.

through door bolts—(See door bolts, through.)

through shake—Shake which extends between two faces of a timber.

tie, adzed—Tie surfaced at the rail bearing points.

tie, bored—Tie with holes bored to receive spikes.

tie, composite—Tie, the essential parts of which are composed of two or more materials.

tie, cross—Transverse member of a railway track supporting the rails, by means of which the rails are held in position.

tie, crossover—Tie of a set used to support a crossover.

tie, cull—Tie which does not conform to specifications.

tie, doty—Tie affected by a fungous disease.

tie, half-round—Slab tie having greater width on lower than on upper face.

tie, head block—Tie or ties of a set used to support the switchpoint operating mechanism.

tie, hewed—Tie hewed at least on two sides.

tie, intermediate—Any tie used between joint ties.

tie, joint—Tie used under a rail joint.

tie, pecky—Tie made from a cypress tree affected by a fungous disease, known locally as peck.

tie, pole—Tie made from a tree of such size that not more than one tie can be made from a section; hewed or sawed on two parallel faces.

tie, quartered—Tie made from a tree of such size that four ties only are made from a section.

tie, sawed—Tie having both faces and sides sawed.

tie, slab—Tie made from the first or outside cut of a log.

tie, slabbed—Tie sawed on the faces only.

tie, split—Tie made from a tree of such size that by splitting two or more ties can be made from a section.

tie, steel—Tie, the essential parts of which are of steel.

tie, substitute—Any tie other than of wood.

tie, switch—Tie of a set used to support a turnout.

tie, tapped—Tie made from a tree, the resin or turpentine of which has been extracted before felling.

tie, treated—Tie which has been subjected to a process designed to protect it from decay.

tie, triangular—Sawed tie whose cross-section is triangular.

tie, wane—Squared tie showing on one of the corners part of the original surface of the tree.

tie face—Upper or lower surface of a tie.

tie plate—Metal plate placed between rail and tie to give greater bearing surface to the rail, thereby reducing rail-cutting.

tie plug—Wooden plugs used for plugging old spike holes or borings.

tip—Small end of a pile or pole.

tram bale—(See bale, tram.)

train—A number of tram cars placed together to form a charge for treatment.

train cable—Flexible wire rope used for pulling charges from cylinder and about yard.

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treat (verb)—Act of giving wood a preservative treatment.

treatment—Amount of preservative specified as injected into timber. Usually expressed in pounds per cubic foot.

treatment, empty cell—(See empty cell treatment.)

treatment, full cell—(See full cell treatment.)

treatment to refusal—(See refusal treatment.)

turpentine scars—Scars due to boxing or cutting trunks of growing trees for resinous products.

tyloses—Cells growing in the vessels or pores of some classes of timber, such as white oak, black locust, osage, orange, etc. Where tyloses are abundant timber is practically impervious to treatment.

ullage—The amount which a tank or vessel lacks of being full.

underground tank—(See drain tank.)

vacuum, final—Vacuum applied as the final step in a treating process, used to aid removal of surplus preservative injected, and for drying the timber.

vacuum, initial—Vacuum sometimes applied as the first step in treating operation.

vacuum line—(See piping, vacuum line.)

vacuum pump—(See pump, vacuum.)

wane—Bark or deficiency of wood on corner of a timber.

water-free oil—Oil showing no water whatever when analyzed by the standard method of this Association.

water thief—(See thief, water.)

wet oil—Oil containing a higher percentage of water than allowed in specifications.

wind shake—Shake caused during growth, supposedly by strong winds.

yard sheaves—(See sheaves, yard.)

Z iron—(See S iron.)

zinc chloride—Salt strongly toxic to wood-destroying fungi. First used as a timber preservative by Sir Wm. Burnett in England about 1838.

zone ratio—Ratio of zone volume to entire volume present. (See zone sample.)

zone sample—A sample taken from any desired zone or depth in a tank or car.

zone sampler—Instrument for taking samples and so arranged that samples may be taken from any desired zone or depth in a tank or car.

MR. F. J. ANGIER: If we start in to criticize all of these definitions we could keep at it all day. I do not understand that this report is intended to go into the MANUAL, and I shall, if it is in order, make a motion that the report be accepted as information to be printed in the PROCEEDINGS, and also in the HANDBOOK when a new edition is printed.

DR. HERMANN von SCHRENK: I second the motion.

THE PRESIDENT: Those in favor of accepting the Committee's recommendation will please say "aye," those opposed "no." The "ayes" have it.

Will Mr. Trumbull please take the Chair?

(The First Vice-President then took the Chair.)

THE FIRST VICE-PRESIDENT: We will now hear the report of the Committee on Publications. We have an opportunity now to make Mr. Foley toe the mark the way he has made the rest of us do during the convention.

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REPORT OF COMMITTEE ON PUBLICATIONS.

To the Members of the American Wood-Preservers' Association:

The use of printer's ink is and has been the principal activity of our Association. That is necessarily the case with any national organization which would acquaint its scattered members with one another and their work. Over two-thirds of our expenditures are involved in the issuance of publications. The visible evidence of our associate activities in our publications. By their appearance and their contents we are judged by those who would rate us as a factor in the industry we aim to represent. Consequently, a committee to be responsible for publications was a logical development in the growth of the American Wood-Preservers' Association.

The Committee on Publications, 1917, was instructed to select and edit manuscripts; to make up copy; to vize proof; to determine advertising, sale and subscription rates; to solicit advertisements and subscriptions; to engage an editor and any other assistance required in the issuance of publications; and through the Secretary-Treasurer, to procure and award bids on publications, and to contract for advertising, sales, or subscriptions. At meetings in New York, its members vized the manuscripts and proofs of the PROCEEDINGS and WOOD-PRESERVING and gave consideration to other problems within their province. By mail throughout the year they acted on matters referred to them. They recommended an increase in advertising rates to meet the increased cost of printing, and the Executive Committee approved their proposal. The old and new rates are as follows:

Publications.	Page		Half Page		Quarter Page	
	Old	New	Old	New	Old	New
Proceedings	$30.00	$40.00	$15.00	$25.00	$9.00	$15.00
Wood-Preserving	40.00	50.00	25.00	35.00	15.00	25.00
Combination	$60.00	$75.00	$35.00	$50.00	$20.00	$30.00

During 1917 the Committee on Publications strove particularly to reduce the cost to the Association of its publications and to reduce the number of typographical errors in them. What has been accomplished in both these directions gives hope of greater progress next year. The 1918 printing contracts are more favorable than those of 1917, and with further pushing of the business and of our publications the net cost to the Association can be reduced still more.

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Results satisfactory to all concerned will come only when every member of the Association cooperates with the Committee on Publications. By acquainting the latter with errors noticed, by contributing articles, or items of news, or by obtaining subscribers and advertisers, each member can help.

Some idea of the cost of issuing the various publications of the Association may be had from the following statements for 1917:

Publications.	Receipts.	Expenses.	Profit or Loss.	
Proceedings	$1,268.91	$3,604.28	L.	$2,335.37
Wood-Preserving	1,749.28	1,470.40	P.	278.88
Handbook	625.44	556.16	P.	69.28
Manual	.....	27.76	L.	27.76

The above sums were apportioned as follows:

Publications.	Receipts.			Expenses.		
	Advertising	Sales	Total	Printing	All other	Total
Proceedings	$1,045.63	$223.28	$1,268.91	$3.042.22	$562.06	$3,604.28
Wood-Preserving	1,563.57	185.71	1,749.28	1,103.65	366.75	1,470.40
Handbook	.....	625.44	625.44	467.95	88.21	556.16
Manual	.....	.....	.....	.....	27.76	27.76
Total	$2,609.20	$1,034.43	$3,643.63	$4.613.82	$1,044.78	$5,658.60
Per cent. of total.	71.61	28.39	100.00	81.54	18.46	100.00

A more detailed account of the financial situation of each publication is given in the following paragraphs:

Proceedings.

The report of the proceedings at our Annual Meeting is the most important undertaking of the Association. It will continue the most expensive until its advertising and sales make it self-supporting. The detailed expenses for the 1917 PROCEEDINGS are as follows:

RECEIPTS.	
Sales	$ 223.28
Advertising	1,045.63
Total	$1,268.91

EXPENSES.	
Printing—Service-test tables	$ 555.70
Other matter	2,486.52
Reporting	202.00
Editing	169.81
Copyright	1.25
Statistics	60.00
Postage and expressage	96.10
Storage and drayage	1.40
Stationery	31.41
Total	$3,604.28

Deficit, $2,335.37

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As was the case with the 1916 PROCEEDINGS, those of the 1917 Annual Meeting cost more than usual on account of including many service-test tables. The 1917 issuance of these tables was a cooperative arrangement with the American Railway Engineering Association, made before the appointment of the Committee on Publications of the American Wood-Preservers' Association, and the latter Committee had no supervision over the arranging, proof-reading, or printing of these data.

Wood-Preserving.

The quarterly journal of our Association made its own way in 1917 for the first time. It has grown in four years from 8 to 48 pages. Its circulation is constantly widening, there now being over 200 subscribers outside the members of the Association, scattered throughout the United States and in Canada, Mexico, Honolulu, England, South Africa, Holland and Russia.

Of the 70 advertisers who patronized the pages of WOOD-PRESERVING during 1917, nearly one-half (34, to be exact) were not members of the Association. This significant fact indicates that advertising in WOOD-PRESERVING is a good business investment and not merely a contribution to a good cause.

The finances of WOOD-PRESERVING to date are as follows:

RECEIPTS.	1914.	1915.	1916.	1917.
Subscriptions	$33.00	$129.00	$183.00	$185.71
Advertising	133.67	623.89	1,074.57	1,563.57
Total	$166.67	$752.89	$1,257.57	$1,749.28
DISBURSEMENTS.				
Printing 4 issues	$349.25	$ 720.96	$ 904.74	$1,103.65
Editor and stenographer	165.00	310.00	301.60	300.00
Postage	31.83	52.16	50.28	22.93
Office supplies and stationery	50.96	61.15	68.96	43.82
Total	$597.04	$1,144.27	$1,325.58	$1,470.40
Profit or loss	L. $430.37	L. $321.38	L. $68.01	P. $278.88

Handbook on Wood-Preservation.

There are on hand only 150 of the 1,500 HANDBOOKS issued in 1917. When sold, they will add to the profit of $69.28 shown below:

RECEIPTS.		
Cash from sales	$592.56	
Due from sales	32.88	
		$625.44
EXPENSES.		
Printing 1500 copies	$467.95	
Copyright	1.25	
Postage and expressage	56.98	
Stationery and printing	29.98	
		$556.16
Profit		$69.28

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The HANDBOOK has assisted in disseminating information on wood-preservation among those who are not intimately acquainted with the industry and used by practitioners for reference in answering inquiries of correspondents seeking general knowledge on the subject.

Manual of Recommended Practice.

The tardiness of members in voting by letter-ballot on the standards recommended and approved at the 1917 Annual Meeting is responsible for the MANUAL not being in the hands of members now. It is hoped that any standard or amendments approved at the 1918 Meeting will be voted on promptly, so as to be available, if adopted, when the MANUAL is issued early this year.

It is desired to include in the MANUAL all tables and formulae that are of service to plant operators, and it is earnestly requested that members send such data to the Committee on Publications in order that the MANUAL may be more complete. A subjective index to all the PROCEEDINGS will supplement the standards and other useful information of reference value in the MANUAL.

JOHN FOLEY, *Chairman.*
E. W. BRIGHT.
E. G. DRAPER.
WM. A. FISHER.
C. E. GOSLINE.
FRANK SCHILLING.
L. B. SHIPLEY.

THE PRESIDENT: The Committee submits this report as information and moves that it be accepted as such.

MR. WILLIAM A. FISHER: I second the motion.

THE FIRST VICE-PRESIDENT: Gentlemen, in asking for the question I would like to make just one or two remarks to the effect that the majority of the members of the Association probably do not appreciate the importance of committee work and the presentation of committee reports at conventions. The value of the work of the Association is largely due to the organization of committee work. The manner in which the work of this Association is presented to prospective customers, to railroads, to those who seek the information in regard to the industry, in libraries, etc., is due very largely to the work of the Committee on Publications. The Association is singularly fortunate in having had such men as Mr. Foley and his associates Chairman and members of this Committee. The membership should thoroughly appreciate what this has meant to the Association and to the industry at large. All those in favor of the

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motion will manifest it by saying "aye"; those opposed by the same sign. Carried.

(The President then took the Chair.)

THE PRESIDENT: We will now hear from the Committee on Non-Pressure Treatments. Is Mr. Griffin present?

MR. M. K. TRUMBULL: I have not seen him this morning. Mr. Hosford is coming on the 20th Century Limited. Mr. Griffin is anxious that Mr. Hosford should be present at the time of the presentation.

THE PRESIDENT: We can postpone this paper to the last in the hope that Mr. Hosford will arrive. Mr. Davidson, would you mind presenting your report now?

MR. G. M. DAVIDSON: Mr. Chairman, the Auditing Committee has gone over the books of the Treasurer and checked up the disbursements with the vouchers and the bank statement and found everything correct.

THE PRESIDENT: Is the Committee on Resolutions prepared to make its report; Mr. Look or Mr. Smith?

MR. S. R. CHURCH: Mr. President, is a remark in order on the question of the returns by letter ballot that was brought up in the report of the Committee on Publications?

THE PRESIDENT: Certainly.

MR. S. R. CHURCH: I think it is almost ridiculous that such a state of affairs should exist as that indicated by the Chairman's report, and at the proper time I would like to see an amendment proposed by a corporate member to the effect that after the members have had the letter ballot for a reasonable length of time and do not reply that another letter ballot should be sent them by registered mail and that if they do not then reply within a reasonable time their vote should be recorded in the affirmative. I do not think that would work a hardship on anyone, and it would enable the Association to proceed with its business.

THE PRESIDENT: All members should appreciate the value of Mr. Church's suggestion. It was deplorable last year that five requests to vote had to be made on many members. The ballots were first sent out in July, and we did not get the necessary two-thirds returned until Christmas. That does not show as much interest in the affairs of the Association as is desirable.

MR. E. B. FULKS: Mr. President, in talking with the Secretary about this yesterday he told me the same things that you have, and he also told me that quite a number of persons on being importuned

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two or three times to vote finally wrote him that they purposely did not vote, because they did not consider themselves competent to vote on that particular thing. They stated they knew nothing about it and preferred not to vote, which is a perfectly reasonable position for a man to take; but quite a number of associations provide in such cases that the person instead of doing nothing simply return his ballot marked in the proper place as not voting on these particular things. That records his vote neither for nor against, but still helps to make the two-thirds vote cast so everyone should consider it and at least vote and send a ballot marked some way or other, either for or against the proposition, or as not voting on that particular thing. Then the two-thirds can be secured. The difficulty this year was not with not securing two-thirds of the votes cast, but of securing two-thirds of all the votes of the Association.

THE PRESIDENT: May we hear from the Committee on Resolutions?

REPORT OF COMMITTEE ON RESOLUTIONS.

To the Members of the American Wood-Preservers' Association:

Your Committee respectfully submits the following resolutions for the careful consideration of members:

Resolution No. 1.

Whereas, The United States has been forced into war with Germany to insure freedom and universal peace, and in order to protect America against monarchial rule and create a national army of sufficient size to win the war; and,

Whereas, The call to the colors nas taken from our ranks no less than 22 members listed below:

J. M. Black	J. W. Fowler	R. S. Manley
S. K. Brown	C. C. Fritz	W. C. Nixon
D. Burkhalter	O. P. M. Goss	T. G. Townsend
J. B. Card	L. E. Hess	H. I. von Leer
G. S. Clarke	E. E. Ingalls	K. M. Waddell
W. H. Cocke	S. B. Lindley	T. W. White
J. T. Dovey	Russell Lord	J. C. Williams
E. G. Draper		

Resolved, That the Association as a body honor the patriotism of these loyal members by a rising vote, and in part compensation for the sacrifices they have made in defense of their country and fellowmen, they be continued on the membership roll until after the war without expense to themselves.

Resolution No. 2.

Whereas, The new postal rates on periodicals, to go into effect next July, will raise the postal rates by an increase of from 50% to 900%, through a zone system; and,

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Whereas Such increase in the postal transportation of periodicals will mean a serious decrease in their circulation and the extinction of many periodicals, thus throttling one of the most important channels by which manufacturers sell their products; and,

Whereas, Such throttling of periodical circulation and the hampering of one of the greatest selling agencies of modern manufactures mean to a great extent the destruction of our manufacturing prosperity; and,

Whereas, This increase of 50% to 900% on periodicals will thus disastrously affect manufacturing interests through the restriction of one of the most important factors in its selling machinery; be it

Resolved, That we urge Congress to repeal this amendment and pledge our energies to secure the repeal of this unjust and destructive law.

Resolution No. 3.

Whereas, The proper construction and maintenance of the highways of the country is necessary to the successful conduct of the war; and,

Whereas, The plans of all highway authorities in the country, all users of highways, and all citizens interested in any way in the highway construction and maintenance, are at the present time upset and tied up; and,

Whereas, There is need for a definite policy so that plans can be formulated for the coming year; and,

Whereas, A properly outlined policy directing the construction and maintenance of such roads and streets as are of general economic and military value will conserve the resources of the country and will greatly facilitate the transportation of freight over highways and streets, be it

Resolved, That the American Wood-Preservers' Association request the United States Government to formulate and promulgate, as soon as possible, a definite policy for road and street construction and maintenance.

Resolution No. 4.

Whereas, It is expedient to intern alien enemies and enemy sympathizers whose conduct imperils or impedes the war; and,

Whereas, It is advisable to forbid the publication of newspapers and magazines in the German language during the war, to minimize the danger of disloyal utterances; and,

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Whereas, It is prudent to forbid the compulsory study of German in the Public Schools, be it

Resolved, That we unite in the National movement to defend American principles and aid in the propaganda to check the spread of German education and usurpation.

Resolution No. 5.

Whereas, Death has removed from our midst on February 6, 1917, our worthy member, C. H. Wiggett, Superintendent of the Tie Plant of the El Paso & Southwestern System, and at one time Superintendent of Treating Plants of the Santa Fe Railway Co. at Bellemont, Ariz., Somerville, Texas, and Albuquerque, N. M.; and,

Whereas, The deceased has always shown his loyalty to our Association and the industry it represents; be it

Resolved, That the American Wood-Preservers' Association tender to the relatives and business associates of the deceased their heartfelt sympathy in their bereavement; and,

Resolved, Further, That the Secretary forward a copy of these condolences to the family and business associates of Mr. Wiggett.

Resolution No. 6.

Whereas, Death has removed from our midst, on February 27, 1917, our worthy member, A. C. Scholtz, Superintendent of the T. J. Moss Tie Company's plant at Mt. Vernon, Ill.; and,

Whereas, The deceased has taken a faithful interest in our Association and the industry it represents; be it

Resolved, That the American Wood-Preservers' Association tender to the relatives and business associates of the deceased their heartfelt sympathy in their bereavement; and,

Resolved, Further, That the Secretary forward a copy of these condolences to the family and business associates of Mr. Scholtz.

RICHARD V. LOOK, *Chairman.*
H. G. JENNISON,
A. E. LARKIN,
F. D. MATTOS,
LOWRY SMITH.

THE PRESIDENT: I believe, gentlemen, it is hardly necessary to ask your approval of these resolutions. We will consider them adopted.

Is the Committee on Non-Pressure Treatments ready to report? Is there any New Business to come before the Association?

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THE SECRETARY: None here, Mr. President.

THE PRESIDENT: I see nothing to do, gentlemen, but to have the report of the Committee on Non-Pressure Treatments read by the Secretary, since no member of that Committee is present.

REPORT OF COMMITTEE ON NON-PRESSURE TREATMENTS.

To the Members of the American Wood-Preservers' Association:

Your Committee was assigned the following subjects to be reported upon at this Meeting:

(1) The treatment of wood without pump pressure.
(2) The use and service of wood treated without pump pressure.

This is the initial year of the Committee on Non-Pressure Treatments. We have felt that the work assigned to us was intended to bring out a general survey of the situation with a view to the designation in the future of such more specific lines of work as consideration of the existing state of the art might make advisable.

The Committee appreciates that in many respects the processes which are discussed in this report will be of interest to most of the members of the Association only in respect to the fact that they are employed for prolonging the life of timber and not because occasion for making use of them is likely to arise. The extensive use of non-pressure processes which we find occurring is, however, evidence of needs not capable of satisfaction through employment of the pressure processes. In some cases, as will be brought out later, the employment of non-pressure processes has been followed by adoption of pressure treatments when the initial experience with wood-preservation demonstrated that greater advantages could be secured by the change.

Those whose personal interest is wholly in pressure treatments, should not, therefore, lose sight of the fact that the use of non-pressure processes is to some extent a preliminary to increased demands upon the branch of the art which they practice.

Treatment of Wood Without Pump Pressure.

A complete census of the non-pressure processes in use at the present time would undoubtedly resemble the chapters of a handbook and involve the description of many processes never encountered by most of the members of this Association in any other place. The taking of any such census was beyond the power of this Committee and we shall therefore describe only five processes, the selection being based either on knowledge of their employment to a considerable extent or upon acquaintance with needs for timber preservation under circumstances which have led to experimental use of the process as best suited to satisfy the particular demand.

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The five processes are as follows:

(a) Brush treatment.
(b) Dipping treatment.
(c) Hot and cold bath treatment.
(d) Kyanizing process.
(e) Boucherie process.

The first three processes are in practice restricted almost wholly to the employment of creosote or other distillates of coal tar, although there is nothing in their methods of application which precludes the use of other organic preservatives or of inorganic compounds. The fourth process is definitely restricted to treatment with solution of corrosive sublimate. The fifth process employs a variety of metallic salts.

BRUSH TREATMENT. Under this name we group all processes involving the application of the preservative to the surfaces of the wood to be treated, by painting, brushing, flowage, etc. The characteristic feature of the process is the application of thin layers of liquid preservative to the surface, dependence being placed upon the absorptive qualities of the timber for its retention.

DIPPING TREATMENT. Under this name we group processes which involve the temporary immersion in the preservative liquid of the timber to be treated. This method is based on the penetration of the external layers of the timber through infiltration or absorption assisted by the expulsion from the cells of the timber of air heated by the surrounding preservative. While the name is based on the practice of submerging the timber in the preservative and removing it therefrom, the same results can be secured if the timber is placed in a tank and the preservative run in, held therein for the proper period and then withdrawn. The period of submersion usually ranges between 5 and 15 minutes.

HOT AND COLD BATH TREATMENT. Under this name we group processes based on the practice first publicly described in Circulars Nos. 101 and 104 of the Forest Service under the name of the Open Tank Treatment. The characteristic features of the treatment are:

> First. The heating of the timber in the preservative for periods ranging from one hour upwards. The function of the hot bath is primarily to expand the air and vaporize the moisture present in the outer layers of the timber. Incidental to this expansion, which drives out a considerable volume of vapor in bubbles, some infiltration of preservative takes place. In some cases, also, the hot bath is called

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upon to produce artificial seasoning of the timber. The temperature of the bath usually ranges between 200° F. and 230° F.

Second. The substitution for the hot bath of a cold bath of the same preservative.

(a) By allowing the hot bath to cool.

(b) By drawing off the hot preservative and replacing it with cold preservative.

(c) By removing the timber from the hot bath and immersing it in a cold bath of preservative.

The function of the cold bath is to chill the expanded vapors in the outer layers of the timber, from which will result a drawing in of preservative to fill the timber cells.

KYANIZING PROCESS. This process consists in immersing the timber in a solution of mercuric chloride. The soaking or "steeping" has to be carried on in vats or tanks made of wood or concrete on account of the corrosive action which the solution exerts on the metals commonly used in construction. The strength of solution employed is usually about 1%. The period of soaking is usually set at n+1 days where n equals the thickness of the timber treated in inches.

BOUCHERIE PROCESS. This process utilizes the pressure of a column of the preservative to secure penetration of the timber. It is necessary to treat the timber shortly after cutting and before removal of the bark. A tight-fitting cap is placed so as to envelop one end of the log, and the preservative fed into it from a vat placed at a suitable higher level. The other end of the log is fixed at a level slightly below that of the capped end. The treatment is terminated when the preservative begins to pass out at the lower end of the log. Several days are required to complete the treatment. Solutions of copper sulphate have most frequently been used as a preservative, but many other salts can be substituted, notably the fluorides of sodium or zinc. The process is specially suited for treating timbers to be used "in the round" such as posts or poles.

Use and Service of Wood Treated Without Pump Pressure.

The Committee sent a questionnaire relating to use and experience with non-pressure processes to

(a) All concerns listed in the 1916 PROCEEDINGS as operating non-pressure plants, and to such other non-pressure operators of which it had knowledge.

(b) To all concerns listed in the 1916 PROCEEDNGS as operating pressure plants.

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The information received is summarized in the following tables:

TABLE 1.

Plants	Number concerns	Number plants		
		Commercial	Private	Total
Reporting	22	11	13	24
Now operating by non-pressure methods	16	9	9	18
Discontinued non-pressure operations	6	2	4	6
Now using pressure methods	6	2	4	6

TABLE 2.

Process in use	Number concerns reporting use	Number plants operated
Brush treatment	3	3
Dipping treatment	9	10
Hot and cold bath	11	12

TABLE 3.

Form of timber treated	Number plants reporting		
	Brush	Dipping	Hot and cold bath
Poles	3	7	10
Cross-arms	..	2	..
Ties (railroad or mine)	..	2	2
Lumber (dimension and plank)	1	..	3
Preservatives used:			
Creosote	1	8	12
Carbolineum	2	9	..

None of the concerns reporting were in a position to furnish service data relative to the material treated, principally on account of too short a time having elapsed since its treatment to give any definite indication as to durability. There is, however, considerable information available as to uses and service, and these are summarized below.

BRUSH TREATMENT. Brush treatments are applied to poles, posts, bridge and other construction timbers, and to lumber in a variety of forms. No statistics are available as to quantity of timber treated or quantity of preservative used. It may be noted, however, that the Census Bureau's 1911 Report on Poles Purchased shows a total of 557,505 treated with "refined coal-tar oils," or a little over 16% of all poles purchased during the year. Most of these poles received a brush treatment. It is practically certain that the per cent. of poles receiving a brush treatment has increased appreciably in recent years. The quantities of creosote and of the carbolineum type of preservatives sold in

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recent years is known to be considerable, probably over 1,000,000 gals. per year. Part of this quantity is applied in "dipping" or in "hot and cold bath" treatments, but the proportion employed in brush treatments is very substantial.

The increase in the life of timber derivable through brush treatments is variable, as would be expected from consideration of the possibility of wide differences with respect to efficiency of application and the conditions of exposure. The experimental treatments of poles placed in service some 12 years ago probably represent as high an efficiency in application as can readily be attained. The gain in life in these experiments has not as yet been definitely ascertained, but has been placed between 3 and 6 years by the investigators following up the experiments.

DIPPING TREATMENT. This treatment has been mainly applied to poles, posts and cross-arms, but ties, dimension timber, and lumber have also been subjected to it in some plants. The 1916 statistics of poles treated in open-tank plants showing a total of 90,766 probably include most of the poles treated by this process together with all poles treated by the "hot and cold bath" process. No data as to life of "dipped" timber were secured, but Committee No. 4 on Service Tests is receiving reports on several experimental installations.

HOT AND COLD BATH TREATMENT. This process was developed for treating the butts of poles, with the aim of so increasing the resistance to decay of the part of the pole enveloped by the soil as to make its period of serviceability more nearly equal to that of the remainder of pole. It has also been employed for the treatment of posts, cross-arms, ties, mine props, dimension timber and lumber. The number of poles treated by this process has increased rapidly and the statistics for 1917 should show a substantial gain over the figure for 1916, referred to above in connection with the "dipping" treatment.

The application of this process for treating fence posts cut from the farm wood lot has been advocated strongly during recent years. Several of the agricultural experiment stations have published bulletins or circulars for distribution to their constituents. A number of experimental installations of posts have been made with a view to gathering reliable data as to life, etc. Committee No. 4 is collecting the data obtained in these experiments for presentation in its annual reports. In view of the work already taken in hand by Committee No. 4 the Committee on Non-Pressure Treatments considered it would involve unnecessary duplication of work to present any details relating to uncompleted life tests.

The service experiments with poles are also being followed by Committee No. 4. The life data of the pole experiments are still

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incomplete as only a few of the oldest butt-treated poles have shown any change from their initial conditions. The oldest recorded experimental installation covers 181 chestnut poles placed in service in 1905. Of 153 poles seasoned before treatment 149 were still unchanged in 1916. The 4 poles showing decay had changed only slightly from their original condition. Of twenty-eight poles treated when green 26 were still unchanged. The two poles showing decay had suffered only slight deterioration. While these results clearly indicate that very substantial and valuable results can be attained through the proper use of this process, it is obviously not yet possible to draw conclusions as to its efficiency with respect to increase in life for the timber treated.

KYANIZING. No data were received from concerns employing this process. The Committee understands that this process is followed in at least three treating plants, and that a variety of forms of timber are treated. No life data based on experience in this country are available. European experience was discussed by Dr. Moll in the paper presented by him before this Association in 1914. The long experience of the German Post Office Administration was summarized therein as indicating a life of 16.5 years for Kyanized pine poles as compared with 4.5 years for untreated poles and 23.0 years for poles treated with creosote.

BOUCHERIE PROCESS. This process requires comparatively inexpensive equipment. The necessary apparatus is light and easily transported. Experimental treatments of poles at North Bloomfield, Cal., for installation in the adjacent National Forest were completed several years ago and are now under observation. Necessity occasionally arises for the use of non-durable timber near the place of growth where conditions preclude its transportation to and from a commercial treating plant. This process is being developed with the thought that it may prove to be of value in such cases.

PRESERVATIVES USED. The principal preservative used in non-pressure process is creosote. The creosote has to be a pure distillate and very fluid at the temperature of use in order to attain the maximum possible in respect to penetration. For the dipping and the hot and cold bath treatments low volatility is a feature of some importance as in these processes the hot creosote is exposed for long periods under conditions highly favorable to evaporation.

In the case of brush treatments any highly toxic liquid preservative of the creosote type seems to be capable of giving fairly good results. Owing to the small quantity of preservative applied to any single piece when this treatment is used, much greater latitude with respect to cost of preservative is possible than with processes in which cost of preservative is the major item. There has in consequence been con-

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siderable employment of such creosote derivatives as the carbolineum types of preservative and also of wood creosote oils.

While there is nothing which prevents the use of metallic salts in any of the non-pressure processes there has been little use made of them except in the case of the two processes which require the employment of aqueous solutions, viz., the Kyanizing and the Boucherie.

RECOMMENDATIONS.

The Committee recommends that assigned work relating to non-pressure processes be restricted for the next few years to the "dipping" and the "hot and cold bath" treatments. Practically all of the established treating plants are concerned only with the applications of these two processes.

We feel that successful Committee work will require the cooperation of producer and consumer, and in the case of the other processes it does not seem possible to secure from the membership of the Association representation for both of these classes. Such representation can be secured for the two processes mentioned above, and the substantial development which these branches of the wood-preserving industry are demonstrating, would in itself justify concentration of our work to their advancement. It is not intended to suggest that the Association should fail to encourage the presentation or discussion of problems related to other non-pressure processes by those who may be interested therein, but rather to secure substantial progress by restricting organized effort to the fields in which the promise is greatest.

R. A. GRIFFIN, *Chairman.*
W. M. CARPENTER,
E. T. CHAPIN,
L. L. HILL,
R. F. HOSFORD.

MR. J. H. WATERMAN: I move you that we accept this report as information.

MR. WILLIAM A. FISHER: I second the motion.

THE PRESIDENT: It has been regularly moved and seconded that it be accepted as information. All those in favor will say "aye"; opposed, "no." The motion is carried.

We will hear from the election tellers; Mr. Cecil.

MR. WM. A. CECIL: Mr. President and Members, the committee has carefully counted the vote cast for officers for the next term, the following members receiving the majority of the votes cast for the offices named:

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For President: M. K. Trumbull (applause).
First Vice-President: J. B. Card (applause).
Second Vice-President: A. R. Joyce (applause).
Secretary-Treasurer: F. J. Angier (applause).
For Executive Committee, three years: E. B. Fulks and E. T. Howson.
For Nominating Committee: E. H. Bowser, Walter Buehler, William A. Fisher, C. F. Ford, Grant B. Shipley and O. C. Steinmayer.

THE PRESIDENT: Gentlemen, you have heard the results of the election. I know they will satisfy everybody, and I shall be glad if Mr. Andrew Gibson will be kind enough to escort President Trumbull to the Chair.

(The new President, Mr. M. K. Trumbull, was then escorted to the Chair).

PRESIDENT TRUMBULL: It would be impossible for me to adequately express my profound appreciation of the honor. I hope I may be able to justify it.

Mr. Foley established a precedent last year by making few remarks when he was inducted into office. This was a desirable precedent.

I have very little to say indeed, excepting to ask that you really appreciate the work of the outgoing President and appreciate the work the Executive Committee has done. If you knew the harmony that prevailed at the meetings of the Executive Committee, and how they strove to advance the interests of the Association and of the industry you would feel that they were good servants.

One thing that strikes me as especially worthy of mention is the engagement of so many of our members in the great conflict in Europe. Much might be said on that subject. The Resolutions Committee has covered the sense of the Association so I think I may not mention it further.

I will not take up your time to offer any comments on the war itself. We are all deeply sensible of what it means to us. We can say little. Our thoughts come from the heart.

It was believed for a while that the effect of the war would possibly mean that this convention might not be held this year. I personally want to express my appreciation for the large number that have come. We have all had to work harder than before, and we have had to work with less return, especially those of us who are engaged in the industries. We have been amply repaid for coming. We have had what appears to be a profitable meeting. The interest that was manifest in some of the discussion recalls the experience before concentrated committee work was inaugurated.

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I can only ask you to "carry on." Much depends upon the work we do now, upon the individual sacrifice we make of our time and of our energy, to promote the industry and this Association. Let us hold together. Let us justify the many years of the building up of this Association.

We have comparatively few of the charter members yet remaining among us, but we appreciate when they come back each year and help us of the younger generation who are trying to learn enough about the business so as to cause the industry to progress. It has had its vicissitudes. It has been built up with a great deal of struggle. The time has now been reached when we need not apologize for the fact that we are engaged in this line of work. The importance of our vocation is recognized not only by our membership but by all those who have anything to do with treated material in any way, shape, or form.

Many of our members are not engaged strictly in wood-preserving, but are engaged in the production of material, untreated material. The importance of their work is greater than it has ever been. The railroads and the Government itself value their effort as never before. These producers are getting greater consideration.

Let us now endeavor to justify the past and to make the future brighter than it has been. The committees which will be assigned shortly will be able to carry on the work that has been so ably started by the committees we have had in the past. We are going to need new members. We have had a number cut off during the last year for one reason or another which it is unnecessary to mention. We urge all to do your utmost to secure recruits, for we need them. We start in this year with a smaller membership than we had last year, which has a very good reason back of it, but this calls for redoubled effort.

We hope that all the members will be able to pay their dues promptly, because the Secretary—and he only represents the Association—needs the money. He has to figure in advance so that the PROCEEDINGS can be published and the other functions of his office may be properly performed.

In conclusion I express the hope we will have as good a meeting next year as we have had this. I hope you all may be present, and that we may not only have a profitable meeting, but that we may renew our acquaintance and enjoy seeing the old faces again. I am sure it is a great pleasure to be able to come each year and to see you gentlemen. I feel as if I have made a number of friends among the Association members that will remain with me for the remainder of

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my life. I thank you for your friendship and for the trust you have placed in my keeping (applause).

It is very unfortunate we are unable to have our First Vice-President led to the Chair. We all know where he is. Our hearts are with him. It is in the record that we have not overlooked him. When he receives his copy of the PROCEEDINGS, and receives his copy of the Resolutions, he will know that we all wish that he could be present, and value the importance of his name in our industry.

The Second Vice-President-elect is Mr. A. R. Joyce. I desire to appoint Mr. Lowry Smith to escort him to the Chair.

(Vice-President A. R. Joyce was then escorted to the Chair by Mr. Lowry Smith.)

MR. A. R. JOYCE: You know there is one thing about the Anglo-Saxon race we learned about last night, and that is this "carry on" business. But over on the other side when it becomes the duty of the junior officer to "carry on," it is because his senior officer is out of action indefinitely. He may never come back. We are going to "carry on," but we have with us and back of us not only the spirit of all the officers who have served so ably, but we have them with us, and it is a big help (applause).

PRESIDENT TRUMBULL: Gentlemen, Mr. Angier, our able Secretary, is sitting beside me. It will be unnecessary to have someone assist him. It is unseemly to introduce him to you. I feel more like introducing all of you to him. I feel that the honor is ours to have such a man as Secretary, one who has done so much for the Association. Mr. Angier now takes office.

SECRETARY ANGIER: Gentlemen, it is indeed most gratifying to me for this very nice introduction by our incoming President. Mr. Trumbull is the ninth President under whom I have had the pleasure of serving as your Secretary. At times the wheels of our industry seem to move slowly, and we become more or less discouraged, at which times the feeling comes over me that I may have outlived my usefulness as Secretary and should step aside and give the opportunity to others with more vim to take up the reins. I must again assure you, however, that the work has been a real pleasure for me, and especially so when we think of the valuable service we are rendering our country in conserving its natural resources. Even though our progress is often beset with obstacles not easily overcome, I have not by any means lost interest in the work, and as I apparently have your unanimous support, I will gladly continue to serve you, hoping that the year 1918 will show better results than any year in the history of our Association. I thank you (applause).

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PRESIDENT TRUMBULL: We have two newly elected members on the Executive Committee, Mr. Fulks and Mr. Howson. Mr. Howson cannot be here today inasmuch as he is in New York City, but we would like to have Mr. Fulks come to the platform and be regularly inducted into office (applause).

MR. E. B. FULKS: I do not think there is any requirement for any speech for an ordinary tail-end member of the Executive Committee.

PRESIDENT TRUMBULL: Well, we are all cogs and he is just as important as any of us. That is the way I feel about it. I do not know that there is anything further. We would like to have the members of the new Executive Committee in the Delph Room at 12:30 so that we may begin making plans for the coming year. Unless someone has something to say I will declare the convention adjourned.

The Fourteenth Annual Meeting of the American Wood-Preservers' Association then adjourned.

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STATISTICAL DATA

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QUANTITY OF WOOD TREATED AND PRESERVATIVES USED IN THE UNITED STATES IN 1917.

By R. K. Helphenstine, Jr., U. S. Forest Service.

The American Wood-Preservers' Association

In Cooperation with the United States Department of Agriculture, Forest Service, Henry S. Graves, Forester; Office of Industrial Investigations, H. S. Betts, Engineer in Forest Products, in Charge.

Summary.

The total quantity of wood treated in 1917 by the 115 treating plants which were in operation was 137,338,586 cu. ft. as compared with 150,522,982 cu. ft. treated by the 117 plants which were active in 1916. This represents a decrease of 13,184,396 cu. ft., or 8.7%.

The number of crossties treated during the year was 33,459,470, or 4,009,898 less than the 37,469,368 reported in 1916. The quantity of piling treated in 1917 was greater than for the year previous by 4,700 lin. ft., while the quantity of wood blocks reported by the plants for the year was less by 327,501 sq. yds. or 8.6%. An increase of 53,527 poles was recorded during the year over the 328,517 reported in 1916. The quantity of construction timber and miscellaneous material treated by the plants in 1917 was less by 948,210 bd. ft. and 3,276,192 bd. ft., respectively.

In 1917 the quantity of preservatives used by the treating plants amounted to 72,564,345 gals. of coal-tar creosote, 2,977,392 gals. of water-gas tar, 7,579,819 gals. of paving oil, and 137,361 gals. of miscellaneous preservatives. In addition 26,444,689 lbs. of zinc chloride were consumed by the industry during the year. The amount of creosote used in 1917 was less by 14,863,012 gals. than the 1916 consumption, while an increase of 1,904,724 gals. of paving oil was recorded over the figure shown for 1916. The 2,977,392 gals. of water-gas tar reported by the treating plants during the year amounts to over twice as much as was reported during the year previous, while the amount of miscellaneous preservatives consumed was less than in 1916 by 445,393 gals. The 26,444,689 lbs. of zinc chloride used by the plants during the year represents a decrease of 301,888 lbs. from the quantity reported in 1916.

Source of Statistics.

In 1917 a total of 115 plants were in operation; of this number 104 furnished the Forest Service with signed statements covering their activities for the period covered by the report. For the remaining

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11 or 9.6% of the entire number on the list estimates were computed. These estimates were based on the reports submitted by other plants of a corresponding type and comparable treating equipment. This was done in order to make the statistics as complete as possible and to more nearly harmonize the 1917 figures with those for 1916, for which year similar estimates were also made for several plants which failed to report.

TABLE 1.—TREATING PLANTS IN THE UNITED STATES, 1917.

Status.	Commercial.			Railroad.			Private.			Total
	Pressure.	Non-pressure.	Pressure and non-pressure.	Pressure.	Non-pressure.	Pressure and non-pressure.	Pressure.	Non-pressure.	Pressure and non-pressure.	
Active	61	5	3	27	1	1	5	11	1	115
Idle	3	2	1	0	0	0	0	3	0	9
Abandoned	0	0	0	1	0	0	0	3	0	4
Total	64	7	4	28	1	1	5	17	1	128

As shown in Table 1, most of the treating plants of this country are of the pressure-cylinder type. The data presented in this report cover only the consumption of preservatives and material treated by those establishments which maintain treating-plant equipment. It does not include brush-treated material or that treated with temporary apparatus in small amounts for special purposes. Consumers of this character are so numerous that it would be a difficult matter to obtain such statistics.

The objects in collecting the statistics are:

(1) To show the progress of wood-preservation in the United States.

(2) To indicate the relative demand for the different preservatives in the various regions of the United States.

(3) To show the amount of timber treated by species and classes of material as an aid for suggesting new fields of development for individual treating plants.

(4) To show the quantities of imported and domestic creosote consumed, thus pointing out the principal sources of supply.

(5) To contribute data relating to treated wood of value as a National Defense measure to the War and Navy Departments.

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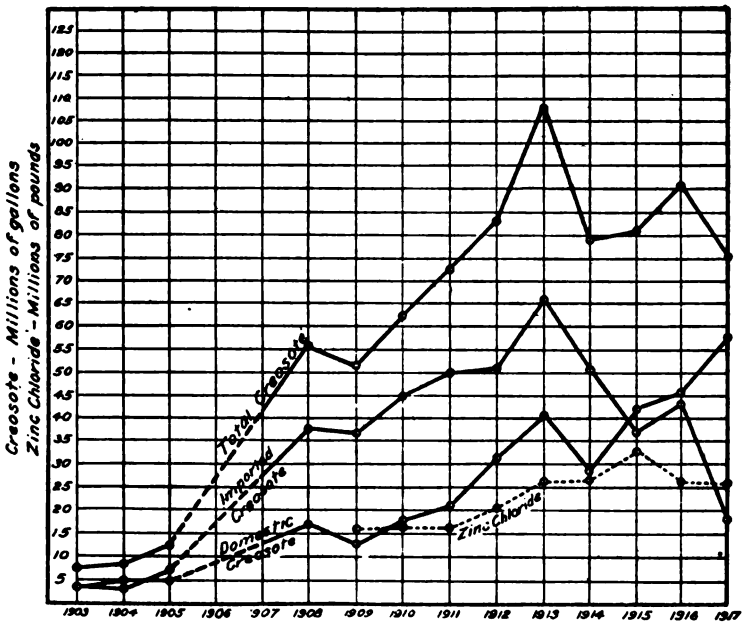
Progress in the Wood-Preserving Industry.

The reduced consumption of preservatives and the corresponding decrease in the amount of material treated during 1917 would in normal times be indicative of a decline in the industry. Such, however, was not a true condition, but one due to a number of existing conditions brought about by the present war. One of the most important factors which influenced the industry during the year was the shortage of preservatives. As indicated in Table 4 the importation of foreign oil was just a little more than one-fifth the amount shipped from abroad in 1916. This curtailment of imported oil was only slightly replaced by an increased production of the domestic product. On the other hand, the increased demand for preservatives in this country, due to the wooden shipbuilding program and other lines of Government work, diverted into these channels a considerable quantity of domestic oil which ordinarily would have gone to the treating plants and further offset the shortage of imported oil.

PROGRESS OF WOOD PRESERVATION IN THE UNITED STATES.

Consumption of Creosote and Zinc Chloride from 1903 to 1917.



NOTE—Figures for Creosote not available for years 1906 and 1907 nor for Zinc Chloride prior to 1909.

OFFICE OF INDUSTRIAL INVESTIGATIONS, U. S. FOREST SERVICE.

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An innovation in the line of treating-plant equipment consists of a portable outfit of the pressure type recently put into commercial use by an eastern concern. The plant is designed for the treatment of crossties, and consists of a 3-cylinder treating car, 2 track cars, a machinery car and a tank car, all equipped for standard gauge tracks. The cylinders are 63 ft. long and 4 ft. in diameter, and are arranged in the form of a pyramid. Suspended from the cylinder car are two oil pumps of sufficient capacity to maintain a pressure of 200 and 500 lbs. per square inch, respectively. The machinery car is equipped with a boiler and the latest type of adzing and boring machine.

After passing through the machinery car the ties are conveyed on rollers to the track car and are loaded into cylinder trucks. Seven trucks containing approximately 105 ties constitute a charge for each cylinder. The charges are withdrawn from the cylinders to the opposite sides of the track cars and from these loaded directly into railway cars. The cylinders are worked in a cycle, in such a manner that all three charges are being operated upon simultaneously. The withdrawal of the preservative without vent from one cylinder creates a vacuum in that cylinder, and the introduction of the oil withdrawn into the next cylinder forces the compressed air which it contains together with an oil spray into the third cylinder. In this plant the oil pumps serve the three-fold purpose of transferring the oil, creating pressure and circulating compressed air, and providing a vacuum. The plant has a capacity of 2,000 ties per 24 hours.

Consumption of Preservatives.

The quantity of wood-preservatives consumed by the treating plants of the United States by years and kinds of preservatives is shown in Table 2. The quantity used in 1917 was 75,541,737 gals., or 14,863,012 gals. less than was employed during the previous year. An increase of 1,904,724 gals. or 33% was recorded in the quantity of paving oil reported during the year over the 1916 figure.

In 1917 the consumption of zinc chloride amounted to 26,444,689 lbs., or less by 301,888 lbs. than was reported in the year previous. Of this quantity 8,549,849 lbs. were reported in the form of 50% solution.

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It can be seen from the table that a gradual decrease in the consumption of miscellaneous preservatives has occurred since 1914. In 1917 the quantity used was only 137,361 gallons or 445,393 gallons less than was reported in 1916.

TABLE 2.—CONSUMPTION OF WOOD PRESERVATIVES BY THE TREATING PLANTS OF THE UNITED STATES, 1909 TO 1917.

Year.	Plants.	Creosote.[a]	Zinc Chloride.	Other Preservatives.[b]
	Number.	Gallons.	Pounds.	Gallons.
1909	64	51,431,212	16,215,107	[c]
1910	71	63,266,271	16,802,532	2,333,707
1911	80	73,027,335	16,359,797	1,000,000
1912	84	83,666,490	20,751,711	3,072,462
1913	93	108,373,359	26,466,803	3,885,738
1914	94	79,334,606	27,212,259	9,429,444[d] 2,486,637
1915	102	80,859,442	33,269,604	3,205,563[d] 1,693,544
1916	117	90,404,749	26,746,577	5,675,095[d] 582,754
1917	115	75,541,737	26,444,689	7,579,819[d] 137,361

(a) Includes coal-tar creosote and water-gas tar.
(b) Includes refined coal tar, corrosive sublimate, and carbolineum oils.
(c) Statistics not available.
(d) Paving oil.

Table 3 shows by regions for 1916 and 1917 the range of prices paid for coal-tar creosote, water-gas tar, zinc chloride in 50% solution and zinc chloride fused. Increases in the cost of preservatives in 1917 are recorded for both zinc and oil in all of the five regions listed over the prices paid in 1916.

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TABLE 3.—PRICES PAID FOR PRESERVATIVES, 1916 AND 1917.

Region.	1916				1917			
	Coal-tar creosote.	Water-gas tar.	Zinc chloride.		Coal-tar creosote.	Water-gas tar.	Zinc chloride.	
			50% Solut'n	Fused.			50% Solution.	Fused.
	Per Gallon.			Per Pound.	Per Gallon.	Per Gallon.	Per Pound.	Per Pound.
Atlantic Coast	$0.075 to $0.09	....	....	$0.06	$0.08 to $0.115	$0.047 to $0.06	$0.0338	$.....
Southern Coast	.08 " .1014	....	....	.0325 to .095	.065 " .23	.08	.04	0.0635 to $0.08
Interior Eastern	.075 " .095	....	....	.058 " .075	.08 " .17	.0425 " .065	.0285 to .075	.0625 " .07
Interior Western	.075 " .135	....	....	.0533 " .074	.0845 " .1214	....	.065	.065 " .085
Pacific Coast	.075 " 135	....	....	.0533 " .065	.1268 " .23	....	....	.07 " .085

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The monthly importation of creosote oil in 1916 and 1917 is shown in Table 4. The total for 1917 indicates that only half as much was shipped in as was actually reported as having been consumed by the plants during that year. Of the total of 18,259,141 gals. reported by the industry as having been used during 1917 at least half was imported during years previous to 1917.

TABLE 4.—MONTHLY IMPORTS OF FOREIGN CREOSOTE, 1916 AND 1917.

Month.	1916	1917
January	5,477,439	2,294,151
February	2,722,797	2,428,216
March	5,121,242	1,247,116
April	5,657,982	245,588
May	3,757,459	153,161
June	1,608 927	211,235
July	6,919,870	1,577,009
August	2,765 121	486,174
September	3,442,296	241,313
October	1,554,169	366,846
November	5,279,003	375,036
December	2,538 112	192,363
Total	46,844,417	9,818,208

* Monthly summary of Foreign Commerce of the United States, Bureau of Foreign and Domestic Commerce.

The relative quantities of foreign and domestic creosote used in 1917 are shown in Table 5. The quantity of foreign oil reported by the plants in 1917 was 18,259,141 gals., or 53.5% less than the 43,649,931 gals. reported in 1916. Of the total quantity of foreign creosote reported used, 15,921,750 gals were imported from England, 1,096.566 gals. from Canada and 1,240,825 gals. from Japan.

TABLE 5.—RELATIVE QUANTITIES OF DOMESTIC AND IMPORTED CREOSOTE USED BY THE TREATING PLANTS OF THE UNITED STATES, 1909 TO 1917.

Year.	Total Creosote Used.	Domestic Creosote.	Per Cent of Total.	Imported Creosote.	Per Cent of Total.
	Gallons.	Gallons.		Gallons.	
1909	51,426,212	13,862,171	27	37,569,041	73
1910	63,266,271	18,184,355	29	45,081,916	71
1911	73,027,335	21,510,629	29	51,516,706	71
1912	83,666,490	31,135,195	37	52.531,295	63
1913	108,373,359	41,700,167	38	66,673,192	62
1914	79,334.606	28,026,870	35	51,307,736	65
1915	80,859,442	43,358,435a	54	37,501,007	46
1916	90,404,749	46,754,818b	52	43,649,931	48
1917	75,541,737	57,282,596c	76	18,259,141	24

(a) 41,333,890 gals. coal-tar creosote and 2,024,545 gals. water-gas tar.
(b) 45,318,735 gals. coal-tar creosote and 1,436,083 gals. water-gas tar.
(c) 54,305,204 gals. coal-tar creosote and 2,977,392 gals. water-gas tar.

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Regional Division of the Wood-Preserving Industry.

In compiling the statistics on wood-preservation in the United States the total area for the country has been divided into five main divisions, as shown on the accompanying map. Table 6 gives the figures for these regions and shows both the quantity of preservatives consumed and the amount of material treated by the plants embraced in each region. The material is here shown in the form and quantity as reported by the plants instead of in cubic feet as presented in Table 8.

The divisions shown were made with a view of conforming the areas embraced as far as practicable to the Forest Service sub-divisions into which this country's original forests have been divided. The divisions referred to are as follows:

(1) ATLANTIC COAST REGION, embracing the Northern Forest made up largely of white pine, spruce, hemlock, tamarack and their associated species.

(2) SOUTHERN COAST REGION, which practically covers the territory included in the Southern Forest where the yellow pines predominate.

(3) THE INTERIOR EASTERN REGION, comprising the Hardwood Forest, the only region in the United States where the hardwoods, such as oak, maple and beech, predominate.

(4) INTERIOR WESTERN REGION, coinciding with the Rocky Mountain Forest, throughout which western yellow pine occurs in company with lodgepole pine, larch, and other softwoods.

(5) PACIFIC COAST REGION, the area covered by the Pacific Forest, where conifers such as Douglas fir, redwood, and western yellow pine occur almost to the exclusion of hardwoods.

Consumption of Preservatives and Treatment of Material.

ATLANTIC COAST REGION.

Twenty-one plants were active in this region during 1917. They used a total of 20,311,765 gals. of coal-tar creosote, water-gas tar and paving oil combined. Of this amount 3,712,510 gals. were imported and 16,599,255 gals., or over four times as much was of domestic production. The quantity of zinc chloride reported by the plants of the region was 1,501,667 lbs. This was less than was reported by any of the other four regions, and shows a decrease from the 1916 figures of 377,709 lbs. The quantity of miscellaneous preservatives used was 27,500 gals.

There was subjected to treatment in this region during 1917 a total of 4,574,540 crossties, or 542,440 less than the number reported

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TABLE 6.—MATERIAL CONSUMED IN WOOD-PRESERVATION IN UNITED STATES, 1916 AND 1917.

Region.	Year.	Plants.	Domestic creosote*	Foreign creosote.	Zinc chloride.	Other preservatives.	Hewed ties.	Sawed ties.	Piles.	Poles.	Wood blocks.	Construction timber	Crossarms.	Miscellaneous.
		No.	Gallons.	Gallons.	Pounds.	Gallons	Number.	Number.	Lin. ft.	No.	Sq. yds.	Bd. ft.	No.	Bd. ft.
Atlantic Coast	1916	21	15,240,997	8,805,439	1,879,376	148,550	3,809,070	1,707,910	4,347,824	12,992	405,267	30,108,195	18,425	2,761,503
	1917	21	16,599,255	3,712,510	1,501,667	27,500	3,227,299	1,347,241	4,341,239	27,481	487,744	26,615,085	18,425	2,892,197
Southern Coast	1916	31	13,722,940	24,206,836	5,827,206	389,066	8,524,223	2,527,785	5,539,949	138,656	1,141,063	69,260,630	197,102	7,773,725
	1917	31	21,918,292	11,094,714	6,368,762	47,935	7,843,323	2,126,824	5,461,322	91,400	931,646	71,228,058	363,236	4,085,393
Interior Eastern	1916	33	20,301,735	5,712,796	12,818,944	24,000	12,373,774	2,820,966	75,301	102 233	1,827,327	20,871,615	11,905	950,038
	1917	33	22,616,769	1,336,228	12,629,685	4,737	11,527,582	2,723,894	166,910	154,197	1,925,068	24,856,340	6,980	879,434
Interior Western	1916	14	1,093,620	1,904,804	3,967,535	2,002	1,731,386	1,569,879	120,250	11,441	.....	8,563,644	78	1,186,539
	1917	13	499,484	218,437	3,937,021	2,257	1,671,065	1,187,593	22,646	37,536	.....	6,310,373	449	509,579
Pacific Coast	1916	18	2,070,743	3,020,056	2,253,516	19,136	61,501	2,342,874	2,607,543	63,195	414,884	19,085,138	64,267	352,195
	1917	17	3,228,515	1,897,252	2,007,554	54,932	541,939	1,263,210	2,703,450	71,430	116,582	8,931,056	4,007	1,381,305
Grand Total	1916	117	52,430,035	43,649,931	26,746,577	582,754	26,499,954	10,969,414	12,690,867	328,517	3,788,541	138,889,222	291,778	13,024,000
	1917	115	64,862,415	18,259,141	26,444,689	137,361	24,811,208	8,648,262	12,695,567	382,044	3,461,040	137,940,912	413,097	9,747,808

* Includes coal-tar creosote, water-gas tar, and paving oil.

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in 1916. The quantity of piling treated during 1917 fell short of the 1916 figure by 6,585 lin. ft., while a gain of 14,489 was recorded in the number of poles run through the cylinders. The quantities reported in 1917 for wood blocks and miscellaneous material show a gain of 82,477 sq. yds. of the former, and 130,694 bd. ft. of the latter over the 1916 figures. The amount of construction timber treated by the plants of the region was 26,615,085 bd. ft. as compared with 30,108,195 bd. ft. for the year previous, while by a strange conincidence the number of cross arme impregnated with preservatives was the same for both years.

SOUTHERN COAST REGION.

As was the case in 1916, the plants of this region headed the list in 1917 in the consumption of creosote, the total amount used by the 31 plants which reported being 33,013,006 gals. Of this amount 11,094,-714 gals. were imported and 21,918,292 gals. of domestic manufacture, the latter including water-gas tar and paving oil as well as coal-tar creosote. The plants of this region consumed 6,368,762 lbs. of zinc chloride, or next to the largest quantity reported. The amount consumed represents an increase over the quantity reported in 1916 of 541,556 lbs. The amount of miscellaneous preservatives used by the plants of the Southern Coast Region in 1917 was 47,935, or less than one-eighth of the quantity reported for the year before.

Though this region ranked second in the treatment of crossties, the number reported for the year was less than in 1916 by 1,082,361. The Southern Coast Region held first place in the quantity of construction timbers treated, the amount reported being 71,228,058 bd. ft., or more than half the total quantity reported for the entire United States. In the treatment of this class of material a gain of 1,967,428 bd. ft. was recorded over the quantity treated by the plants of the region in 1916. The amount of piling and the number of poles reported by the region in 1917 was less than for the year previous by 78,627 lin. ft. of the former, and 47,256 of the latter. A decrease from the previous year's figures of 3,688,332 bd. ft. of miscellaneous material and 209,417 sq. yds. of wood blocks was recorded by the plants of the region, while the number of cross-arms treated was nearly double the quantity reported in 1916.

INTERIOR EASTERN REGION.

The 33 plants of the Interior Eastern Region consumed in 1917 the second largest amount of creosote. Of a total of 23,952,997 gals. reported, 22,616,769 gals. were of domestic production, and 1,336,228 gals. were imported. The figure shown for the domestic oil includes not only coal-tar creosote, but also water-gas tar and paving oil. The region ranked first in the consumption of zinc chloride, the 12,629,685 lbs. reported being less than the quantity used in 1916 by

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189,259 lbs. The amount of miscellaneous preservatives used during the year was less by 19,263 gals. than was reported the year before.

In the treatment of cross-ties the plants of this region ranked first with a total of 14,251,476. Increases were recorded in 1917 in all but two of the remaining six classes of material treated over the quantities reported in 1916. The two classes which showed lesser amounts were cross arms and miscellaneous material, and the reductions registered were 4,925 of the former and 70,604 bd. ft. of the latter.

INTERIOR WESTERN REGION.

The number of plants that were active in this region in 1917 was 13, or one less than the number which reported in 1916. These plants used in 1917 the smallest quantity of creosote, the amount consumed being 717,921 gals., or less than one-fourth the amount consumed in 1916. Of the total quantity employed 499,484 gals. were of domestic manufacture, and 218,437 gals. were imported. The plants of this region used during the year approximately 30,000 lbs. of zinc chloride less than was reported for the year previous, while the quantity of miscellaneous preservatives was greater by 255 gals.

The number of cross-ties treated by the plants of the Interior Western Region in 1917 was 2,858,658, or 422,607 less than were reported in 1916. The quantity of piling treated by the plants of this region was the smallest reported and amounted to less than one-fifth the quantity shown for the region in 1916. Over three times as many poles were given preservative treatment in the region in 1917 as in 1916, and the number of cross arms reported was greater by 371. As was the case in 1916, no wood blocks were treated in the region in 1917, while the quantities of construction timbers and miscellaneous material treated were less by 2,253,271 bd. ft. and 676,960 bd. ft. respectively.

PACIFIC COAST REGION.

The number of active plants in this region in 1917 was one less than the number in 1916. The total was 17, and they consumed 5,125,867 gals. of creosote, of which 1,897,252 gals. were imported and 3,228,615 gals. domestic. The domestic oil included coal-tar creosote, water-gas tar and paving oil. A total of 2,007,554 lbs. of zinc chloride were consumed by the plants of the region, and 54,932 gals. of miscellaneous preservatives.

Decreases were registered in the quantity treated by the plants of this region in 1917 from the 1916 figures in all but one of the seven classes of material shown in Table 6. The one class which showed an increase was poles, of which there were treated 71,430 as compared with 63,195 for the year before.

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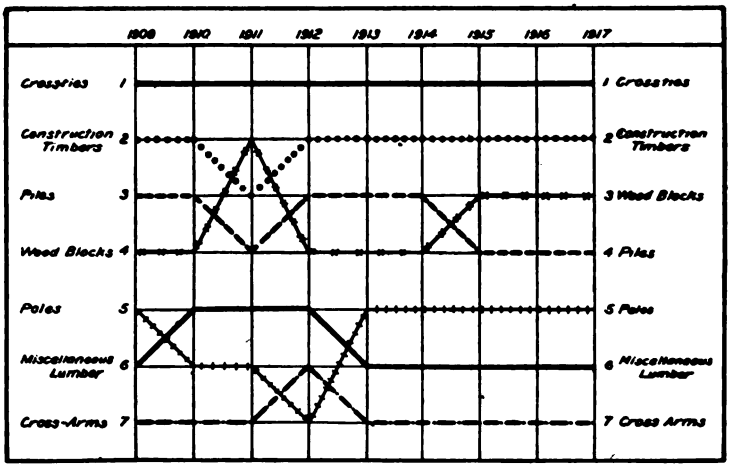
RELATIVE RANK OF THE SEVEN CLASSES OF MATERIAL TREATED, 1909 TO 1917.



Preservation of Ties.

Railroad timber, principally ties, has always constituted the major portion of the material treated in this country. In 1917 a total of 137,338,586 cu. ft. of wood was impregnated with preservatives, of which 100,378,410 cu. ft., or over 73% were ties. The number of ties treated in 1917 was 33,459,470, or 4,009,898 less than were reported in 1916. Of the total number treated 24,811,208 were hewed and 8,648,262 sawed.

Oak ties were treated in the largest number, constituting 40.2% of the total number reported. Yellow pine ties ranked second with 34.5% and Douglas fir was third in importance with 8.2%. The number of ties of each kind of wood reported, the per cent. of which each represents of the total, and the kind of preservative used in treatment are shown in Table 7.

A total of 16,436,573 crossties were treated with creosote in 1917 and 14,843,318 with zinc chloride. The number of ties treated with these two preservatives in combination was 2,160,682, while 18,897 were subjected to treatment with miscellaneous preservatives. In treating ties with creosote, water-gas tar or paving oil the average injection was 7.95 lbs. per cu. ft. For zinc chloride it was 0.46 lb. per cu. ft. Where ties were treated with creosote in combination with zinc chloride the quantity of preservatives forced into the wood averaged 2.98 lbs. per cu. ft. for the former and 0.46 lb. for the latter. The Bethell,

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TABLE 7.—NUMBER OF CROSS-TIES TREATED IN UNITED STATES IN 1917.

Preservatives.	Oak.	Yellow pine.	Douglas fir.	Western pine.	Beech.	Gum.	Tamarack.	Maple.	Birch.	Elm.	Other species.	Total.
Creosote	6,023,513	8,250,461	134,123	182,372	682,102	251,926	355,250	190,311	164,623	.....	201,892	16,436,573
Zinc chloride	6,288,111	2,487,074	2,601,198	964,493	837,277	67,073	640,118	306,210	10,661	5,102	636,001	14,843,318
Zinc chloride and creosote	1,128,768	791,586	.....	.....	77,551	3,795	.....	18,767	1,000	.....	139,215	2,160,682
Miscellaneous	.....	18,897	.....	.....	.....	.....	.....	.....	.....	.....	.....	18,897
Total	13,440,392	11,548,018	2,735,321	1,146,865	1,596,930	322,794	995,368	515,288	176,284	5,102	977,108	33,459,470
Per cent of total treated.	40.2	34.5	8.2	3.4	4.8	1.0	3.0	1.5	0.5	.....	2.9	100

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Boiling, Boulton, Burnett, Card, Lowry, Rueping and Open-Tank processes were employed by the plants in the treatment of ties in 1917.

Preservation of Piles.

In 1917 there was treated a total of 12,695,567 lin. ft. of piles, consisting principally of Southern yellow pine and Douglas fir. The Southern Coast Region again ranked first in the quantity treated with 5,461,322 lin. ft. The Atlantic Coast Region came second with 4,341,239 lin. ft., and was followed in the order of the quantity treated by the Pacific Coast Region with 2,703,450 lin. ft., the Interior Eastern Region with 166,910 lin ft., and the Interior Western Region with 22,646 lin. ft.

In treating piles with creosote an average absorption of 13.83 lbs. per cubic foot was obtained. With zinc chloride, the only other preservative used, an average of 0.69 lb. per cubic foot was forced into the wood.

The principal processes used were the Bethell, Boiling, Boulton, Burnett and Rueping.

Preservation of Poles.

The statistics presented in this report include only those poles which were treated in either pressure or open-tank plants. They do not take into account poles treated by painting (brush treatment). It is probable that as many poles are subjected annually to this latter type of treatment as are reported by the treating plants. The number of poles impregnated with preservatives by the treating plants in 1917 was 382,044, or 53,527 more than were reported in 1916.

In the treatment of poles, coal-tar creosote, water-gas tar, paving oil and zinc chloride were the preservatives used. For the first three mentioned the average injection was 12.23 lbs. per cubic foot, and for the zinc chloride it was 0.50 lb. per cubic foot. The Bethell, Boulton, Burnett, Lowry, Full-Cell, Open-Tank and Dipping were the processes employed in treatment.

Preservation of Wood Blocks.

In 1917 a total of 3,461,040 sq. yds. of wood blocks were treated, as compared with 3,788,541 sq. yds. in 1916. Of the qunatity treated 1,607,562 sq. yds. were for inside flooring and 1,853,478 sq. yds. for outside paving. Yellow pine blocks held first place, the quantity treated being 2,921,189 sq. yds. Tamarack was second in rank with 378,149 sq. yds., and Douglas fir and Norway pine came third and fourth in the order named with 117,412 sq. yds. and 44,290 sq. yds., respectively. The four woods mentioned were used in very nearly equal proportions for both inside flooring and outside paving.

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Creosote, paving oil and zinc chloride were the three preservatives used. In treating blocks for use as flooring the average injection for creosote and paving oil was 8.18 lbs. per cubic foot, while for those blocks intended for paving material the average absorption was 14.65 lbs. per cubic foot. Zinc chloride was used in the treatment of blocks for flooring purposes only and the quantity of the preservative forced into the wood averaged 0.53 lb. per cubic foot.

The processes used in the preservation of wood blocks were the Bethell, Boiling, Boulton, Burnett and Rueping.

Preservation of Construction Timber.

Construction timber includes bridge timber, switch ties and other heavy wooden structural material. The total amount of construction timber treated by the plants in 1917 was 137,940,912 bd. ft., or 848,310 bd. ft. less than was reported in 1916. The Southern Coast Region was again the leader in the treatment of this class of material with a total of 71,228,058 bd. ft., or more than half the entire amount reported for the whole country. Though the Atlantic Coast Region still ranked second with 26,615,085 bd. ft., the quantity reported was less than the amount treated in 1916 by 3,493,110 bd. ft.

As was the case in 1916 yellow pine constituted the major portion of the material treated throughout the United States, except in the Pacific Coast Region, where it consisted of Douglas fir to the exclusion of all other species.

The preservatives used in the treatment of construction timber were creosote, paving oil, and water-gas tar either separately or in combination, zinc chloride and creosote in the form of an emulsion and straight zinc chloride. Where the various oils mentioned were employed the average injection was 11.01 lbs. per cubic foot. For zinc chloride it was 0.47 lb. per cubic foot, and for the emulsion 2.57 lbs. of creosote and 0.49 lb. of zinc chloride per cubic foot were forced into the wood.

Practically all wood-preserving processes were employed, including the Bethell, Boiling, Boulton, Burnett, Card, Lowry, Rueping and Open-Tank.

Preservation of Cross-Arms.

A considerable gain was recorded in 1917 over 1916 in the number of cross-arms treated. The total for 1917 was 413,097 as compared with 291,778 reported for the year previous. This increase occurred principally in the Southern Coast Region, where nearly twice as many cross-arms were treated this year as were run through the cylinders in 1916.

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Creosote and paving oil were the preservatives used in the treatment of this class of material, and the average injection per cubic foot of wood was 11.97 lbs. The processes employed were the Bethell, Boiling, Rueping and Open-Tank.

Preservation of Miscellaneous Lumber.

This class of material in 1917 consisted of wooden conduit, fence posts, tie plugs, pipe staves, mine lagging, anchor slugs, filler strips, pole steps, railroad track markers, sheet piling, tank staves, telephone line stubs and miscellaneous lumber, planking and small dimension material. The total amount of material of this character subjected to treatment during the year was 9,747,808 bd. ft. This was 3,276,192 bd. ft. less than were reported in 1916.

Creosote, paving oil and water-gas tar were used separately and in combination, and the average impregnation for the group of preservatives was 10.85 lbs. per cubic foot. In using zinc chloride alone an average injection of 0.50 lb. per cubic foot was obtained, while in the case of the zinc-creosote emulsion the absorption of preservatives per cubic foot was 3 lbs. of creosote and 0.50 lb. of zinc. Practically all of the principal wood-preserving processes were employed in the treatment of this character of material.

Total Material Treated.

Table 8 summarizes in cubic feet the total amount of material in each class from 1909 to 1917 and indicates the quantity treated in these years according to the kind of preservative employed.

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TABLE 8.—MATERIAL TREATED IN THE UNITED STATES, 1909 TO 1917.

Preservatives.	Year.	Cross-ties.	Piles.	Poles.	Wood blocks.	Cross-arms.	Construction timbers.	Lumber and miscellaneous.	Total material treated
		Cu. ft.	Cu. ft.	Cu. ft	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.	Cu. ft.
Creosote	1909	29,830,060	4,421,726	659,664	2,994,290	41,764	4,902,311	417,787	43,267,622
	1910	44,525,229	5,219,254	255,597	4,692,453	88,069	7,801,272	2,687,713	65,269,587
	1911	49,532,163	4,937,363	106,213	10,145,724	71,961	7,417,105	2,499,995	74,710,524
	1912	57,461,515	7,624,939	1,169,981	7,091,658	1,643,128	6,892,493	2,841,195	84,724,909
	1913	75,998,307	7,630,328	2,367,769	6,810,308	1,813,010	10,308,883	1,853,993	106,782,598
	1914	67,774,329	7,804,657	1,188,511	3,127,506	395,403	8,389,158	1,348,566	90,028,130
	1915	51,231,207	6,288,238	2,336,318	6,054,758	87,373	9,264,164	881,028	76,153,086
	1916	62,576,403	8,524,680	6,303,954	7,205,953	178,210	9,521,609	691,870	95,002,679
	1917	48,685,554	8,493 715	5,930,559	4,610,427	239,764	7,830,673	706,084	76,496,776
Zinc chloride	1909	24,153,162	a	a	a	a	320,891	2,333	24,476,386
	1910	27,587,583	a	a	a	a	541,514	71,060	28,200,157
	1911	28,337,883	a	a	a	a	1,043,851	119,931	29,501,665
	1912	28,532,874	a	18,246	a	a	259,972	20,092	28,831,184
	1913	36,051,816	a	47,996	a	a	585,756	7,670	36,693,238
	1914	50,020,755	a	b	a	a	1,317,925	4,355	51,343,035
	1915	53,457,852	4,726	a	a	a	2,406,150	275,279	56,144,007
	1916	43 859,028	859	164	a	a	1,526,881	346,047	45,732,979
	1917	44,529,954	7,093	45,788	10,421	a	2,127,872	5,070	46,726,198
Zinc-creosote	1909	8,095,794	a	a	a	a	62,918	43,699	8,202,411
	1910	6,354,219	38,392	a	a	a	181,143	30,646	6,604,400
	1911	7,312,374	b	a	a	a	b	b	7,312,374
	1912	8,214,303	97,874	a	a	a	560,613	99,367	8,972,157
	1913	6,938,838	327,594	a	b	a	758,989	53,628	8,079,049
	1914	5,868,834	a	a	b	a	140,718	b	6,009,552
	1915	6,548,136	2,320	110,220	a	a	40,396	4,822	6,705,894
	1916	5,935,242	837	53,933	a	a	359,428	a	6,349,440
	1917	6,482,046	a	a	a	a	1,102,635	847	7,585,528
Miscellaneous	1909	a	a	a	a	a	a	a	a
	1910	a	a	a	a	a	a	a	a
	1911	a	a	a	a	a	a	a	a
	1912	2,974,317	14,222	352	305,437	a	80,446	28,032	3,402,806
	1913	1,792,287	a	84,655	45,985	11,709	a	124,367	2,059,003
	1914	7,877,043	257,245	293,896	3,741,864	22,511	a	9,363	12,201,922
	1915	19,560	a	66,242	1,643,213	3,254	123,377	330	1,855,976
	1916	37,431	56,458	389,031	2,738,731	2,634	166,183	47,416	3,437,884
	1917	680,856	85,204	749,156	4,464,382	16,274	433,896	100,316	6,530,064
All preservatives	1909	62,079,036	4,421,726	659,664	2,994,290	41,764	5,286,120	463,819	75,946,419
	1910	78,467,031	5,257,646	255,597	4,692,453	88,069	8,523,929	2,789,419	100,074,144
	1911	85,182,420	4,937,363	106,213	10,145,724	71,961	8,460,956	2,619,926	111,524,563
	1912	97,183,009	7,737,035	1,188,579	7,397,095	1,643,128	7,793,521	2,988,686	125,931,056
	1913	120,781,248	7,957,922	2,500,420	6,856,293	1,824,719	11,653,628	2,039,658	153,613,888
	1914	131,540,961	8,061,902	1,482,407	6,869,370	417,914	9,847,801	1,362,284	159,582,639
	1915	111,256,755	6,295,284	2,512,780	7,707,971	90,627	11,834,087	1,161,459	140 858,963
	1916	112,408,104	8,582,834	6,747,062	9,944 684	180,844	11,574,101	1,065,333	150,522,982
	1917	100,379,410	8,586 012	6,725,503	9,085,230	256,038	11,495,076	812,317	137,338,586

(a) No statistics. (b) Figures if used would reveal identity of reporting firms.

COVERING FACTORS.

To obtain the number of cross-ties, divide figures shown by 3.
To obtain the number of linear feet of piling, divide the figures shown by .6763.
To obtain the number of linear feet of poles divide the figures shown by .5868.
To obtain the number of square yards of wood blocks, divide the figures shown by 2.625.
To obtain the number of board feet of construction timbers, multiply the figures shown by 12.
To obtain the number of cross-arms, divide the figures shown by .6198.
To obtain the number of board feet of lumber and miscellaneous material, multiply the figures shown by 12.

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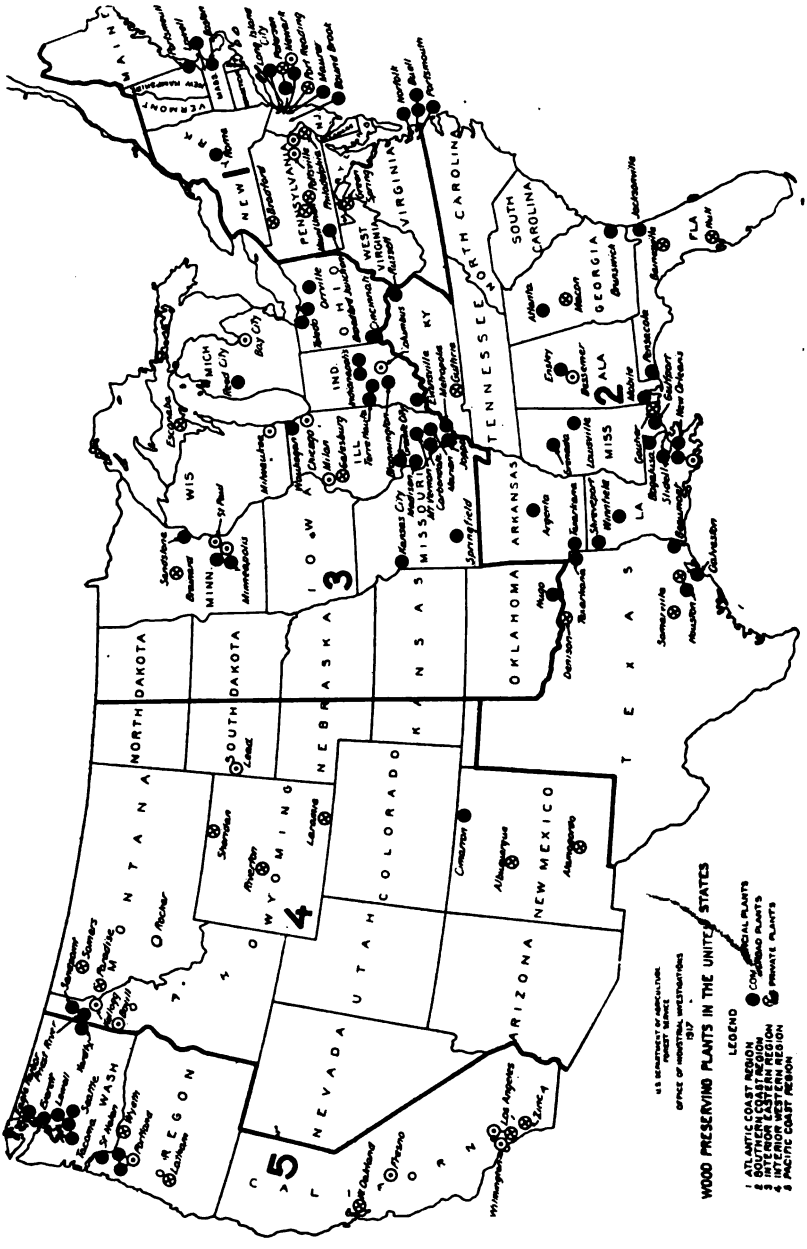

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MILEAGE OF STEAM, HORSE AND ELECTRIC RAILWAYS IN THE UNITED STATES.

Cross-Ties Used and Treated—Treating Plants in Operation.

Year	Steam Railroads		Horse & Elec. Rwys.	Total	Ties used	Ties treated		Treating plants in operation
	First main tracks	Other tracks						
	Miles	Miles	Miles	Miles	Number	Number	Per Cent.	Number
1860	30,626	3,000	200	33,826	10,147,800	From 1860 to		
1870	52,922	9,100	1,200	63,222	18,966,600	1885 inclusive	0.10	3
1880	93,267	21,977	2,000	117,244	35,173,200	Approx. 50,000		
1885	123,320	32,868	2,800	158,988	47,696,400	120,000	0.25	5
1886	125,185	34,441	3,120	162,746	48,823,800	510,000	1.04	5
1887	137,028	37,348	3,680	178,056	53,416,800	594,000	1.11	5
1888	145,387	38,221	4,112	187,720	56,316,000	644,000	1.14	6
1889	153,725	42,242	4,930	200,897	60,269,100	615,000	1.02	7
1890	163,597	42,036	5,241	213,874	64,168,200	650,000	1.01	8
1891	168,403	47,746	6,155	222,304	66,691,200	697,000	1.05	8
1892	171,564	50,787	7,040	229,391	68,817,300	790,000	1.15	9
1893	176,461	53,676	8,870	239,007	71,702,100	812,000	1.13	10
1894	178,709	54,825	8,949	242,483	72,744,900	920,000	1.26	11
1895	180,657	56,237	10,810	247,704	74,311,200	1,289,000	1.73	12
1896	182,777	57,352	12,133	252,262	75,678,600	1,307,000	1.73	13
1897	183,284	58,729	13,756	255,778	76,733,400	1,312,000	1.71	13
1898	184,648	60,686	15,942	261,276	78,382,800	1,826,000	2.33	13
1899	187,535	62,608	17,665	267,808	80,342,400	2,510,000	3.12	15
1900	192,556	66,228	19,314	278,098	83,429,400	2,800,000	3.36	15
1901	195,562	69,790	22,217	287,569	86,270,700	4,101,000	4.75	17
1902	200,155	74,041	25,592	299,788	89,936,400	6,180,000	6.87	22
1903	206,314	78,508	27,754	311,576	93,472,800	9,010,000	9.64	27
1904	212,243	84,830	29,548	326,621	97,986,300	12,800,000	13.06	30
1905	216,974	89,823	32,517	339,314	77,982,000	14,890,000	19.09	34
1906	222,340	94,643	36,212	353,195	102,834,000	16,880,000	16.41	39
1907	227,455	100,520	38,812	366,787	153,700,000	19,856,000	12.92	51
1908	229,203	103,152	40,247	372,602	111,780,600	23,776,000	21.27	57
1909	234,059	106,950	40,490	381,499	114,449,700	22,033,000	19.25	68
1910	239,447	110,936	40,088	390,471	117,141,300	30,544,000	26.08	78
1911	244,476	116,586	41,088	402,150	120,645,000	31,141,000	28.81	81
1912	247,981	121,386	42,110	411,477	123,443,100	32,394,000	26.24	87
1913	250,534	126,038	43,043	419,615	125,884,500	40,260,000	32.00	92
1914	253,997	130,656	43,989	428,642	147,592,600	43,847,000	34.37	95
1915	257,569	133,573	46,613	437,755	131,326,500	37,085,585	28.24	102
1916	260,144	136,700	47,721	444,565	133,369,500	37,469,368	28.10	117
1917	261,123	139,710	49,587	450,420	135,126,000	33,459,470	24.76	115

Mileage of steam railroads from 1890 to 1914 from records of Interstate Commerce Commission.
Cross-ties used and treated from 1906 to 1911 from Census Reports.
Cross-ties used from 1860 to 1905 and from 1912 to 1916 estimated on basis of 300 ties per mile.

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WOOD-PRESERVING PLANTS IN UNITED STATES, CANADA AND MEXICO.

UNITED STATES.

PRESSURE PROCESSES.

Managing company	Headquarters	Location of plant	Year built	Cylinders		
				Number	Diameter inches	Length feet
American Creosoting Co.	New York, N. Y.	Newark, N. J.	1906	1	78	105
				1	78	165
" " "	Louisville, Ky.	Indianapolis, Ind.	1913	2	84	134
" " "	" "	Marion, Ill.	1907	2	84	134
" " "	" "	Springfield, Mo.	1917	2	84	134
" " "	" "	Kansas City, Mo.	1907	2	84	134
" " "	" "	Russell, Ky.	1915	1	84	134
" " "	" "	Hugo, Okla.	1907	2	84	134
American Creosote Works.	New Orleans, La.	Southport, nr. New Orleans	1901	1	84	172
				1	108	172
" " "	" " "	Louisville, Miss.	1912	1	108	172
Anaconda Copper Mining Co.	Butte, Mont.	Rocker, Mont.	1910	1	72	43
A. T. & S. F. Rwy. Co.	Topeka, Kan.	Albuquerque, N. M.	1908	2	74	123
Atlantic Coast Line R. R. Co.	Wilmington, N. C.	Gainesville, Fla.	1912	2	74	138
Atlantic Creo. & W. P. Wks.	Norfolk, Va.	Norfolk, Va.	1901	1	78	62
				1	78	82
				1	78	126
Ayer & Lord Tie Co.	Chicago, Ill.	Grenada, Miss.	1904	4	74	128
" " " "	" "	Argenta, Ark.	1907	4	74	132
" " " "	" "	Carbondale, Ill.	1902	4	72	122
				4	74	132
Baltimore & Ohio R. R. Co.	Baltimore, Md.	Green Spring, W. Va.	1912	2	84	132
Barber Asphalt Paving Co.	Maurer, N. J.	Maurer, N. J.	1905	4	72	115
Boston Elevated Rwy. Co.	Boston, Mass.	South Boston, Mass.	1916	1	90	51
Buffalo, Rochester & Pittsburgh R. R. Co.	Rochester, N. Y.	Bradford, Pa.	1910	1	75	96
Bunker Hill & Sullivan Mg. Co.	Kellogg, Idaho	Kellogg, Idaho	1908	1	84	10
Carbolineum Wood Pres. Co.	Portland, Ore.	Portland, Ore.	1901	1	..	...
Central Creosoting Co.	Chicago, Ill.	Finney, O.	1918	2	72	134
" " "	" "	Terre Haute, Ind.	1912	2	132	30
Central of Ga. R. R. Co.	Macon, Ga.	Macon, Ga.	1912	2	84	116
Central R. R. of New Jersey	Port Reading, N. J.	Port Reading, N. J.	1912	2	88	140
Charlotte Harbor & No. Ry. Co.	Boca Grande, Fla.	Hull, Fla.	1912	1	74	73
C. B. & Q. R. R. Co.	Chicago, Ill.	Galesburg, Ill.	1907	5	74	132
" "	" "	Sheridan, Wyo.	1899	2	74	132
Chicago & N. W. Ry. Co.	" "	Escanaba, Mich.	1903	3	72	112
" " "	" "	Riverton, Wyo.	1915	1	72	110
Colman Co., J. M.	Seattle, Wash.	West Seattle, Wash.	1884	3	75	120
Colonial Creosoting Co.	Louisville, Ky.	Bogalusa, La.	1912	2	72	134
Columbia Creosoting Co.	Portland, Oregon	Linnton, nr. Portland, Ore.	1912	1	72	132
				1	72	65
Compressed Wood Preserving Co.	Cincinnati, O.	Cincinnati, O.	1909	2	72	76
Continental Tie & Lbr. Co.	Denver, Colo.	Cimarron, N. M.	1913	1	84	87
El Paso & S. W. R. R. Co.	El Paso, Tex.	Alamogordo, N. M.	1902	2	72	106
Eppinger & Russell Co.	New York, N. Y.	Long Island City, N. Y.	1878	4	72	100
" " " "	" " "	Jacksonville, Fla.	1909	3	84	130

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WOOD-PRESERVING PLANTS.—(Continued.)

UNITED STATES

PRESSURE PROCESSES.

Managing company	Headquarters	Location of plant	Year built	Cylinders		
				Number	Diameter inches	Length feet
Federal Creosoting Co.	Louisville, Ky.	Bound Brook, N. J.	1909	1	84	150
" " "	" "	Toledo, O.	1909	3	84	134
" " "	" "	Rome, N. Y.	1910	2	84	150
" " "	" "	Paterson, N. J.	1909	1	84	150
Georgia Creosoting Co.	Louisville, Ky.	Brunswick, Ga.	1915	2	84	121
Great Northern Ry. Co.	St. Paul, Minn.	Somers, Mont.	1901	4	72	110
Gulfport Creosoting Co.	Gulfport, Miss.	Gulfport, Miss.	1906	2	84	120
Indiana Creosoting Co.	Louisville, Ky.	Bloomington, Ind.	1907	1	84	134
Indiana Tie Co.	Evansville, Ind.	Evansville, Ind.	1907	2	72	110
" " "	Evansville, Ind.	Joppa, Ill.	1909	2	72	110
Indiana Zinc Creosoting Co.	Terre Haute, Ind.	Terre Haute, Ind.	1904	2	72	120
Interstate Public Service Co.	Indianapolis, Ind.	Columbus, Ind.	1909	1	72	45
Int'l. Creo. & Con. Co.	Galveston, Tex.	Beaumont, Tex.	1892 1897	1 1	108	140
" " " "	" "	Galveston, Tex.	1905	1	72	100
" " " "	" "	Texarkana, Ark.	1902	1 1	114 72	165 125
Jennison-Wright Co.	Toledo, O.	Toledo, O.	1910	2	72	130
Kettle River Co.	Minneapolis, Minn.	Madison, Ill.	1909	4	84	135
" " "	" "	Sandstone, Minn.	1904	2	72	120
Louisiana Creosoting Co.	Winnfield, La.	Winnfield, La.	1906	1 1	72 72	126 80
L. & N. R. R. Co.	Louisville, Ky.	Guthrie, Ky.	1913	2	84	133
" " "	" "	Gautier, Miss.	1895 1916	1 1 1	72 72 84	115 133 133
Los Angeles & S. L. R. R. Co.	Los Angeles, Cal.	Zinc, Cal.	1908	2	72	117
Michigan Pipe Co.	Bay City, Mich.	Bay City, Mich.	1893	1	72	42
Michigan Wood Preserving Co.	Pittsburgh, Pa.	Reed City, Mich.	1913	1	90	90
Midland Creosoting Co.	Toledo, O.	Granite City, Ill.	1917	2	74	140
Mo., Kan. & Tex. Ry. Co.	St. Louis, Mo.	Denison, Tex.	1909	4	72	108
Moss Tie Co., T. J.	" " "	Mt. Vernon, Ill.	1899	1 1	74 72	132 117
Nat'l Lbr. & Creo. Co.	Texarkana, Ark.	Texarkana, Tex.	1910	2	84	132
" " " "	" "	Houston, Tex.	1912	4	72	120
Norfolk Creosoting Co.	Norfolk, Va.	Buell (nr. Norfolk), Va.	1896 1905	4 1 1	78 78 84	100 105 125
Northern Pacific Ry Co.	St. Paul, Minn.	Brainerd, Minn.	1907	2	84	134
" " " "	" "	Paradise, Mont.	1907	2	84	133
Ohio Wood Preserving Co.	Pittsburgh, Pa.	Orrville, O.	1912	1	84	90
Oregon-Wash. R. R. & Nav. Co.	Portland, Oregon	Wyeth, Oregon	1904	4	72	114
Pacific Creosoting Co.	Seattle, Wash.	Eagle Harbor, Wash.	1906	8	73	125
Pennsylvania R. R. Co.	Philadelphia, Pa.	Mount Union, Pa.	1909	1	72	132
" " "	" "	Greenwich, Phila, Pa.	1910	2	72	132

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WOOD-PRESERVING PLANTS.—(Concluded.)

UNITED STATES

PRESSURE PROCESSES.

Managing company	Headquarters	Location of plant	Year built	Cylinders		
				Number	Diameter inches	Length feet
Phila. & Reading Ry.	Port Reading, N. J.	Port Reading, N. J.	1912	2	88	140
Pioneer Lbr. & Creo. Co.	Ensley, Ala.	Ensley, Ala.	1911	1	74	76
Pittsburgh Wood Preserving Co.	Pittsburgh, Pa.	Adelaide, Pa.	1911	1	84	90
Puget Sound Wd. Pres. Co.	Lowell, Wash.	Lowell, Wash.	1895	1	84	117
				1	72	83
				1	72	52
Railway Tie Treating Co.	New York	Portable, Pa.	1917	3	48	63
Republic Creosoting Co.	Indianapolis, Ind.	Mobile, Ala.	1906	2	74	130
" " "	" "	Indianapolis, Ind.	1903	1	74	130
" " "	" "	Seattle, Wash.	1916	1	74	130
" " "	Minneapolis, Minn.	Minneapolis, Minn.	1905	2	74	130
St. Helens Creosoting Co.	Portland, Oregon	St. Helens, Oregon	1912	4	84	136
St. Paul & Tacoma Lbr. Co.	Tacoma, Wash.	Tacoma, Wash.	1912	1	84	130
Santa Fe Tie & Lumber Preserving Co.	Topeka, Kan.	Somerville, Tex.	1906	5	74	122
Shreveport Creosoting Co.	Louisville, Ky.	Shreveport, La.	1910	2	84	134
Southern Creosoting Co.	Slidell, La.	Slidell, La.	1879	1	84	150
			1902	2	72	100
Southern Pacific Co.	San Francisco, Cal.	Latham, Oregon	1893	2	72	117
" " "	" " "	West Oakland, Cal.	1887	1	72	108
				1	72	138
" " "	" " "	Los Angeles, Cal.	1907	2	72	112
Southern Paving & Const. Co.	Chattanooga, Tenn.	Pensacola, Fla.	1912	1	72	90
Southern Wood Pres. Co.	Atlanta, Ga.	Atlanta, Ga.	1908	1	72	100
Tenn. C. I. & R. R. Co.	Birmingham, Ala.	Bessemer, Ala.	1909	1	72	66
Texas & N. O. R. R. Co.	Houston, Tex.	Houston, Tex.	1890	5	72	112
Union Pacific R. R. Co.	Omaha, Neb.	Laramie, Wyo.	1909	4	73	117
			1903	2	73	117
U. S. Gov't Wood Pres. Plant	New Orleans, La.	New Orleans, La.				
U. S. Wood Preserving Co.	New York, N. Y.	Buell (near Norfolk), Va.	1907	2	78	150
Western Wood Pres. Co.	Spokane, Wash.	Yardley, Wash.	1912	1	84	65
Wyckoff Pipe & Creo. Co.	New York, N. Y.	Portsmouth, Va.	1881	4	74	102
Watkins Creosoting Co.	Chicago, Ill.	Metropolis, Ill.	1913	1	74	100

CANADA.

Bruce & Co., Alex.	Glasgow, Scotland	Fort Francis, Ont.	1912	1	84	76
Canada Creosoting Co., Ltd.	Toronto, Ont.	Trenton, Ont.	1913	1	84	134
Dominion Creo. Co., Ltd.	Vancouver, B. C.	Vancouver, B. C.	1910	2	90	100
Dominion Tar & Chem. Co.	Sydney, N. S.	Sydney, N. S.	1911	1	78	85
" " " "	" "	Transcona (nr. Winnipeg), Manitoba	1912	1	78	84
				3	78	135
Vancouver Creosoting Co., Ltd.	Vancouver, B. C.	North Vancouver, B. C.	1916	2	84	135

MEXICO.

No data available regarding treating plants in Mexico. The Mexican Central Railroad built a plant at Aguas Calientas, Mex., in 1901, to treat railroad ties with zinc chloride. About the year 1907 the Madero Co. built a 2-retort plant at Madera, Chihuahua, Mex., to treat railroad ties with zinc chloride.

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WOOD-PRESERVING PLANTS IN UNITED STATES, CANADA AND MEXICO.

UNITED STATES.

NON-PRESSURE PROCESSES.

Managing company	Headquarters	Location of plant	Year built	Tanks or cylinders: Number	Tanks or cylinders: Size feet
n & Son Co., Otis	Lowell, Mass.	Lowell, Mass.	1848	2	4x 8x50
" " "	" "	Portsmouth, N. H.	1875	4	4x 8x50
Anaconda Copper Mg. Co.	Butte, Mont.	Rocker, Mont.	1909	1	10x10x10
Barnes-Lindsley Mfg. Co.	Portland, Oregon	Portland, Oregon	....	.	.....
Baxter & Jordan	Los Angeles, Cal.	Wilmington, Cal.	1911	.	.....
Carbolineum Wd. Pres. Co.	Portland, Oregon	Portland, Oregon	1910	4	3x 4x60
Chapin Co., E. T.	Spokane, Wash.	Bovil, Idaho	1915	2	8x12x11
Del. Lack. & West. R. R. Co.	Scranton, Pa.	Paterson, N. J.	1907	1	6 dia. x32
Homestake Mining Co.	Lead, S. D.	Lead, S. D.	1908	1	4 dia. x38
Lindsley Bros. Co.	Spokane, Wash.	Minneapolis, Minn.	1916	2	14x18x11
" " "	" "	Priest River, Idaho	1910	2	5 dia. x11
Milwaukee Ry. & Light Co.	Milwaukee, Wis.	Milwaukee, Wis.	1910	.	.....
Naugle Pole & Tie Co.	Chicago, Ill.	Chicago, Ill.	1912	2	5x 5x10
New Southern California Edison Co.	Los Angeles, Cal.	Los Angeles, Cal.	1912	3	10.5x8.5x9
Page & Hill Co.	Minneapolis, Minn.	Minneapolis, Minn.	1911	4	6 dia. x11
P. & R. Coal & Iron Co.	Pottsville, Pa.	New Philadelphia, Pa.	1908	1	6 dia. x32
Portland Ry. Light & Power Co.	Portland, Ore.	Portland, Ore.			
Public Service Electric Co.	Newark, N. J.	Newark, N. J.	1909	1	10x32x 2
Puget Sound Wd. P. Co.	Lowell, Wash.	Lowell, Wash.	1895	1	3x10x30
			1915	1	3x 3x30
Reeves Co., The	New Orleans, La.	New Orleans, La.	1910	1	4x 4x30
Republic Creosoting Co.	Mobile, Ala.	Mobile, Ala.	1912	1	3x19x10
San Joaquin L. & P. Co.	Fresno, Cal.	Fresno, Cal.	1910	2	7x 9x 9
St. Paul & Tacoma Lbr. Co.	Tacoma, Wash.	Tacoma, Wash.	1915	4	7x10x30
Southern Pacific Co.	San Francisco, Cal.	West Oakland, Cal.	1911	1	4x 6x 8
United Gas Imp. Co.	Philadelphia, Pa.	Philadelphia, Pa.	....	....	.....
U. S. Govt. Wood Pres. Plant	Milan, Ill.	Milan, Ill.	1908	1	4x 3x42
Valentine-Clark Co.	Minneapolis, Minn.	Minneapolis Transfer,	1908	1	12x14x12
		St. Paul, Minn.	1908	2	8 dia. x12
Washington Creosoting Co.	Everett, Wash.	Everett, Wash.	1916	4	30x 7x10
Western Cedar Pole Preservers	Spokane, Wash.	Sandpoint, Idaho	1916	2	8x24x11
" " " "	" "	" "	1916	1	5 dia. x11

CANADA.

Lindsley Bros.	Spokane, Wash.	Naakup, B. C.	1910	1	6 dia. x12

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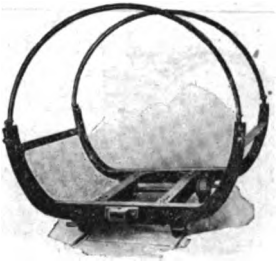

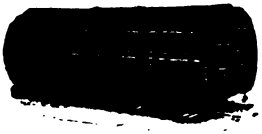

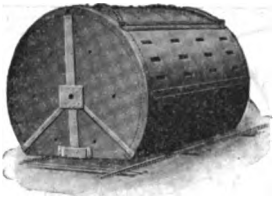

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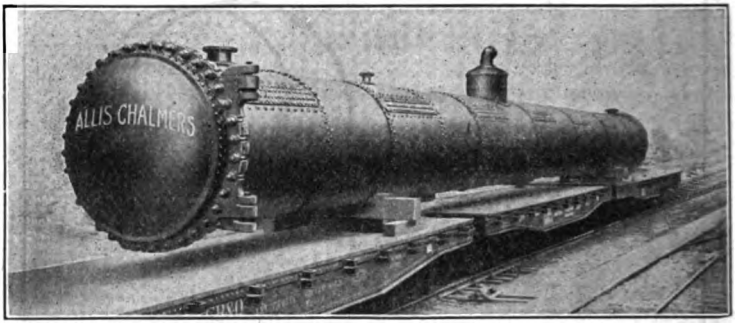

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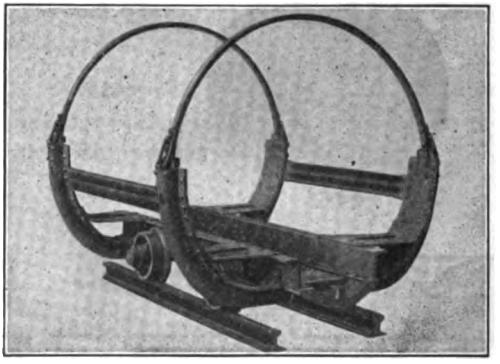

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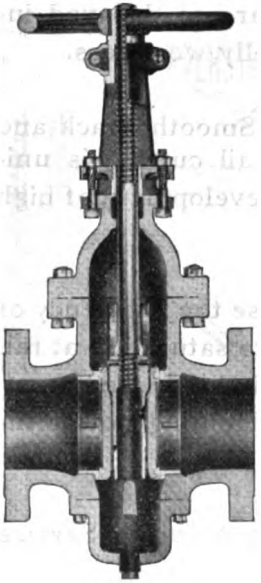

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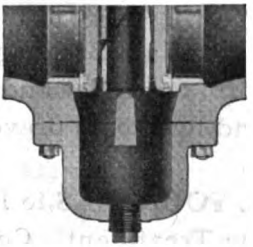

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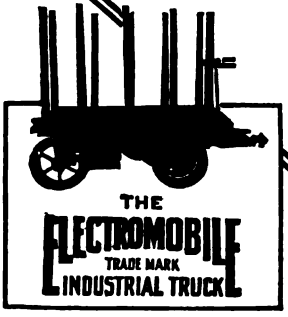

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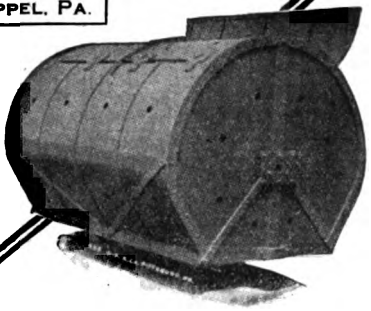

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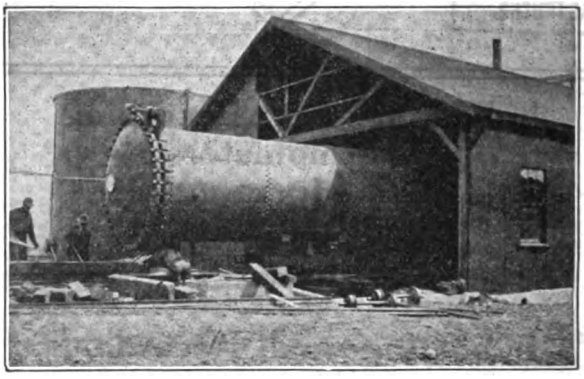

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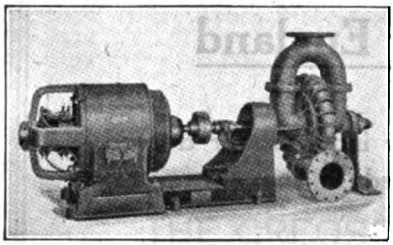

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Lewis Mfg. Co., F. J.
Republic Creosoting Co.

Preservatives.
(See also Creosote, Water Gas Tar, Zinc Chloride, etc.)

Processes.
Card (J. B. Card)
Cecil-Williams (Indiana Tie Co.)
Rueping (Lembcke, von Bernuth Co.)

Publications.
Handbook on Wood Preservation
Manual of Recommended Practice
Proceedings
Wood-Preserving

Pumps.
Yeomans Bros. Co.

Pyrometers.
Schaeffer & Budenberg Mfg. Co.

Retorts.
Card & McArdle
Allis-Chalmers Mfg. Co.
Manitowoc Engineering Works

Roofing.
Barrett Co., The
Lewis Mfg. Co., F. J.

Steam Traps.
Crane Co.

Tanks.
Allis-Chalmers Mfg. Co.
Manitowoc Engineering Works

Tar.
American Tar Products Co.
Barrett Co., The
Lewis Mfg. Co., F. J.

Thermometers.
Schaeffer & Budenberg Co.

Timber—Producers & Dealers.
American Tie & Timber Co.
Ayer & Lord Tie Co.
Eppinger & Russell Co.
Germain Co.
Gress Mfg. Co.
Joyce-Watkins Co.
Indiana Tie Co.
Moss Tie Co., T. J.
Valley Tie and Lumber Co.

Tools—Paving and Roofing.
Lewis Mfg. Co., F. J.

Treated Timber—Ties, Paving Blocks, Etc.
American Creosoting Co. of New York
Atlantic Creo. & Wood Pres. Works.
Ayer & Lord Tie Co.
Card & McArdle
Central Creosoting Co.
Colman, The J. M. Co.
Eppinger & Russell Co.
Indiana Tie Co.
Indiana Zinc-Creosoting Co.
Int'l Creosoting & Construction Co.
Jennison-Wright Co.
Joyce-Watkins Co.
Kettle River Co., The
Michigan Wood-Preserving Co.
Moss Tie Co., T. J.
National Lumber & Creosoting Co.
Ohio Wood Preserving Co.
Pacific Creosoting Co.
Pittsburgh Wood Preserving Co.
Republic Creosoting Co.
St. Helens Creosoting Co.
Southern Creosoting Co.
Southern Wood Preserving Co.
United States Wood Preserving Co.

Water Gas Tar.
American Tar Products Co.
Barrett Co., The
Lewis, The F. J. Mfg. Co.
United Gas Improvement Co.

Zinc Chloride.
General Chemical Co., The
Grasselli Chemical Co., The

Zinc Sulphate.
General Chemical Co.
Grasselli Chemical Co.

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THE

Fifteenth Annual Meeting

OF THE

American Wood-Preservers' Association

WILL BE HELD IN

ST. LOUIS, MO.,

January 28, 29 and 30, 1919

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